THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK AUGUST, 1906

Variations of the Temperature of the Atmosphere in New York City

BY REGINALD PELHAM BOLTON

In the course of the preliminary studies for the equipment of the extensive group of buildings projected by the architects of the New York Central & Hudson River Railroad for its New York Terminal, the writer had occasion to observe the importance of the relative temperatures of night and day time, and entered upon an examination of such variations from the public records of the Weather Bureau for the past ten years.

The record maintained by the New York Herald Weather Bureau was found also to be very convenient, and from these two sources of information, the general features of the annual heating seasons were compared, and those of 1903, 4–5 were found to be fairly representative of annual recurrences of mean, and of minimum, temperatures.

The fluctuations of the season of 1904–5 are plotted on Fig. 1, in two diagrams, the upper showing the variations of mean temperature for each twenty-four hours, and the lower diagram indicating the lowest temperature reached in each similar period.

Averages of both for each month are also plotted, so that from the combination the general heat requirements for this season and for each month are comparable, the maximum demand and the least demand for heat on any day, and the average total heating and average daily maximum for any month.

In large plants the point of daily minimum is of special importance, because the heating load will demand the provision of arrangements for large fluctuations in the boiler output, to meet the minimum temperature experienced at some period in each day.

The daily minimum point representing a particular output, which the plant must be prepared to reach, may be of considerable importance in deciding upon the proportions of apparatus.

In the case of the extensive group of buildings above referred to, it was found, on computation, that a variation of one degree Fahrenheit in outside temperature may eventually represent the work of 150 boiler horsepower.

It became necessary, therefore, to consider in still closer detail the particular period of the occurrence of minimum temperatures, and this inquiry soon disclosed the interesting feature that minimum temperature is not to be, at any time, looked for during the hours of business in daytime, but occurs almost invariably between the period from 3 A. M. to 6 A. M., a curve of almost any given period of twenty-four hours, and of any given series of such periods, having a generally similar character to those indicated in Fig. 2.

On this are plotted the average variations of every hour of the twenty-four of the heating season of 1903–4, and also the particular hourly temperature of the twenty-four of the

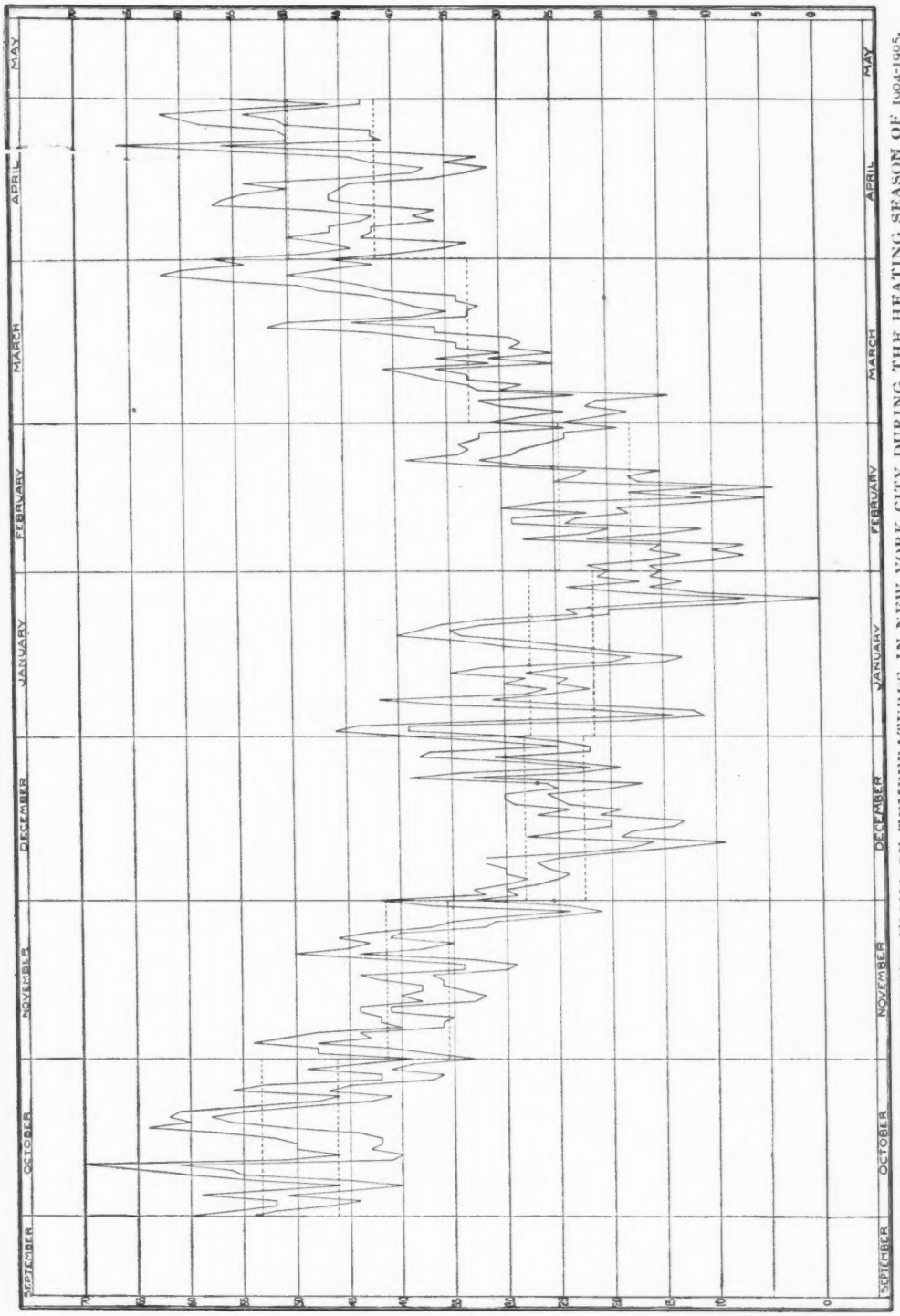
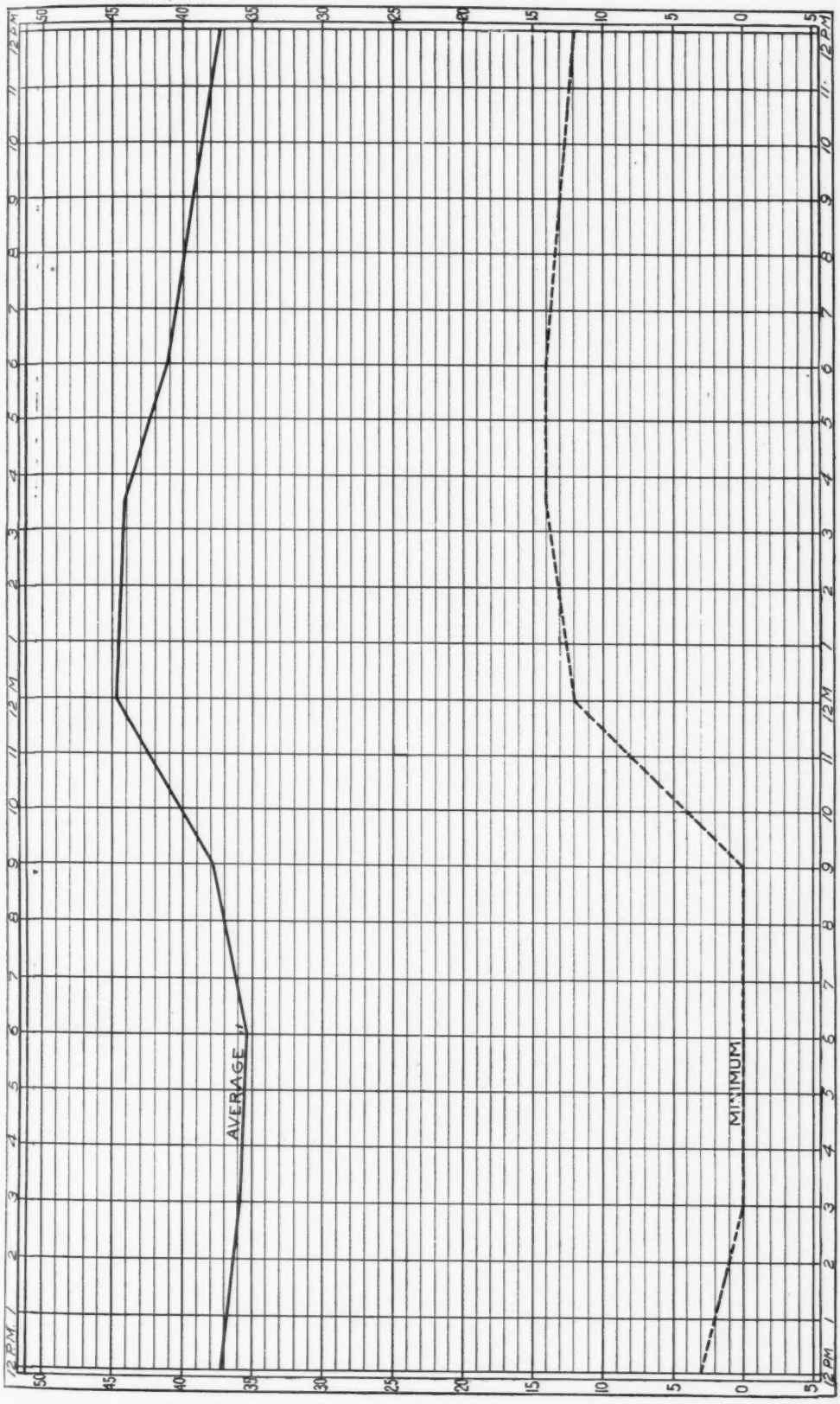


CHART SHOWING DAILY FLUCTUATIONS OF TEMPERATURES IN NEW YORK CITY DURING THE HEATING SEASON OF 1904-1905.
The Upper Line Shows the Average Temperatures During Each Month. The Lower Line Shows the Minimum Temperatures During Each Month. The Dotted Lines Show the Mean and Minimum Averages for Each Month.



AVERAGE TWENTY-FOUR HOUR TEMPERATURE DIAGRAM FOR NEW YORK CITY, DURING THE HEATING SEASON OF 1903-1904.
The Upper Curve is Constructed From Averages of Temperatures at the Same Hours of Every Day. The Lower Curve is the Curve of Temperatures on the Coldest Day, January 5, 1904.

coldest day of that season, viz.: the 5th of January, 1904.

It will be observed that the general characteristic of these temperature fluctuations is a rise in temperature from the period of 6 A. M. to 9 A. M., and a more rapid rise from 9 A. M. to the maximum between 12 noon and 3 P. M. or 4 P. M., thence a gradual descent to the minimum occurring between 3 A. M. and 6 A. M.

From these curves, it becomes evident that in considering the proportions of heating apparatus, the maximum work to be accomplished, which is usually assumed on the assumption of an exterior temperature of zero, is practically a night condition. In business buildings, therefore, which are unoccupied at that period, a less interior temperature may be considered, and the work of the heating plant may be considered to be to that extent relieved.

In considering the relation of a heating load to that of the available exhaust of an operating plant, this feature becomes of considerable importance, and the usual assumption of a continuous zero temperature may be modified.

The calculation of the losses of any particular building appears a somewhat complicated problem, if they are to be figured out for such fluctuations as are thus established, yet such calculations would appear to be of considerable value if readily ascertainable. A diagram is presented (see supplement) in which has been plotted the average variations during each twenty-four hours in each month, and those of the two extreme minimum days all of the season of 1903-4. The fluctuations are inverted so as to read on a scale of differences in temperature between the interior at 70 degrees Fahrenheit and the outside variations.

On either side of the diagram, parallel vertical scales are placed, showing Peclet's losses of heat units, through all usual building constructive materials.

A rule laid across the diagram will enable the reader to ascertain, at a glance, the rate of heat loss, at any hour of the twenty-four, in any month of this average season, through any material, and it is only necessary to multiply the exposed areas of different constructions by the number of heat-units thus scaled off.

The scales are uniform on each side, so that the ruler may be readily placed square and the results read on either side of the sheet.

These diagrams have formed the basis of the elaborate computations conducted by the writer, for the daily and hourly heating load of the New York Central Railroad Terminal buildings, and for their comparison with available variable amounts of exhaust steam, a study which has made evident the value of such closer demonstration of the variations of heat and work between night and day and between one month and others.

Some account of this comparison will, it is hoped, be found of interest at a later date, when the work of computation, which is still in hand, is completed.

ANNOUNCEMENT

Commencing with our October issue, we propose to publish each month a record of the outside temperature variations during the preceding month in the City of New York, together with a record of the wind velocities and directions during that month. It is hoped later to supplement this information with monthly reports of the temperatures in other representative localities

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Proceedings of the Semi-Annual Meeting, Chicago, Ill., July 19-20, 1906

An attendance of nearly 150 members and guests and a record list of more than 25 applications for membership received during the sessions, stamped the semi-annual meeting of the Heating Engineers, held in Chicago, July 19-20 last, as the most successful of its mid-summer meetings, as regards material prosperity. The technical side of the meeting was also eminently successful and the discussions on most of the subjects were highly interesting and instructive.

By far the most important matter coming before the society as new business was the application of the Illinois members for a local chapter of the society for Illinois. This matter gave rise to an extended discussion in which both the advantages and disadvantages of such action were discussed at length. Among the advantages brought forward was the opportunity that would be given to members living in the West, especially those within easy reach of Chicago, to meet more often than they were able to do under present conditions and in that way further the development of the heating and ventilating art in the Middle West, as well as advancing the interests of the society itself. The danger of local chapters occupying the interests of its members to the exclusion of the parent society were pointed out, as well as the possibility that papers that might otherwise be presented to the parent society would be read before the local chapter and thus, according to custom, be debarred from presentation at the main society's meetings. The discussion, however, developed a feeling strongly in favor of granting a charter for a local chapter in Illinois. According to the constitution and by-laws, such action could only be had through an amendment to the by-laws, on a vote taken by mail ballot. It ws voted, therefore, on motion of Mr. James Mackay, that an amendment to the by-laws be submitted to the members providing for the formation of local chapters and, in case of the favorable passage of the amendment, that a chapter be thereupon granted to the members in Illinois.

The hospitality displayed by the Chicago members in entertaining those present was of the typical Western kind and reached its climax in a complimentary dinner at the Auditorium Hotel on the evening following the society's final adjournment. In addition to this there were automobile rides for the ladies and visits, in company with Chicago members, to special points of interest, such as some of the new buildings containing modern heating and ventilating plants. The committee having in charge the entertainment of the visitors was made up of T. J. Waters, August Kehm, James Mackay, John F. Hale, E. F. Carpon and R. A. Widdicombe.

Those present at the various sessions, whose names were entered in the society's register, included the following.

John K. Allen, Chicago, Ill.
A. A. Ainsworth, Chicago, Ill.
R. A. Apperson, Kansas City, Mo.
Geo. C. Andrew, New York.
Albert Aschaffenburg, New Orleans, La.
A. S. Armagnac, New York.
E. P. Allen, Chicago, Ill.
L. W. Butler, Chicago, Ill.
C. D. Brownell, Champaign, Ill.
E. Braatz, Chicago, Ill.
J. J. Blackmore, New York.
S. S. Brewer, Chicago, Ill.
John S. Brennan, Milwaukee, Wis.
Chas. B. Ball, Chicago, Ill.
W. L. Bronaugh, Chicago, Ill.
Eugene Bradley, St. Louis, Mo.
Wm. C. Busche, St. Louis, Mo.
John Boylston, Chicago, Ill.
Chas. R. Bishop, Lockport, N. Y.
W. A. Cameron, Chicago, Ill.
Frank K. Chew, New York.
W. W. Curtis, Chicago, Ill.
John A. Connolly, New York.
E. F. Capron, Chicago, Ill.
D. I. Cook, Chicago, Ill.
H. V. Conine, Chicago, Ill.
W. H. A. Davidson, Chicago, Ill.
Jas. H. Davis, Chicago, Ill.
W. H. Driscoll, Jersey City, N. J.
James A. Donnelly, New York.
Bert C. Davis, Kansas City, Mo.
Geo. E. Downe, Chicago, Ill.
F. W. Davis, Chicago, Ill.
Geo. H. Dickerson, Chicago, Ill.
A. A. Edgar, Philadelphia, Pa.
H. W. Ellis, Chicago, Ill.
Morris R. Ebersole, Chicago, Ill.
W. G. Frantz, Cincinnati, Ohio.
Chas. K. Foster, Chicago, Ill.
W. C. Fergus, Chicago, Ill.

W. B. Gravis, Chicago, Ill.
John Gormly, Philadelphia, Pa.
W. C. Green, Chicago, Ill.
Jos. Graham, New York.
John O. Galloup, Battle Creek, Mich.
Robert L. Gifford, Chicago, Ill.
F. F. Hanley, Chicago, Ill.
J. W. Hoffman, Pullman, Ill.
John F. Hale, Chicago, Ill.
A. T. Hoyt, Warren, Ohio.
F. K. Houston, Rockford, Ill.
J. H. Harating, La Porte, Ind.
Wm. H. Hill, Chicago, Ill.
Geo. D. Hoffman, Chicago, Ill.
Andrew Harvey, Detroit, Mich.
S. S. Howell, Chicago, Ill.
Lloyd Howell, Chicago, Ill.
F. N. Jewett, Chicago, Ill.
A. O. Jones, Battle Creek, Mich.
Benj. Kauffman, Chicago, Ill.
J. H. Kinealy, St. Louis, Mo.
Aug. Kehm, Chicago, Ill.
F. E. Kerr, Chicago, Ill.
A. Kilender, Chicago, Ill.
Henry J. Know, Chicago, Ill.
R. W. Larkin, Chicago, Ill.
S. R. Lewis, Chicago, Ill.
Herbert I. Lord, Chicago, Ill.
H. B. McLelland, Chicago, Ill.
Melvil B. McIntyre, Chicago, Ill.
F. F. McNichol, Oshkosh, Wis.
D. F. Morgan, Chicago, Ill.
J. H. Martin, Jr., Chicago, Ill.
E. McGordon, Jr., Chicago, Ill.
E. H. Murphy, Chicago, Ill.
J. J. Muller, Chicago, Ill.
T. J. Waters, Chicago, Ill.
Wm. M. Mackay, New York.
Jas. Mackay, Chicago, Ill.
Harry S. Martin, Dunkirk, N. Y.
C. D. McArthur, New York.
Everett N. Murphy, Chicago, Ill.
Frank G. McCann, New York.
Edw. P. Mott, Chicago, Ill.
S. J. Madden, Mendota, Ill.
John A. Noone, Chicago, Ill.
Samuel G. Neiler, Chicago, Ill.
Chas. F. Newport, Chicago, Ill.
M. P. Osbourne, Camden, N. J.
H. J. Ott, Chicago, Ill.
Frank G. Phegley, Chicago, Ill.
Wm. D. Pickles, Chicago, Ill.
W. S. Patterson, Appleton, Wis.
N. L. Patterson, Chicago, Ill.
E. J. Ryan, Danville, Ill.
Arthur L. Rice, Chicago, Ill.
E. A. Stark, Chicago, Ill.
Daniel Stern, Chicago, Ill.
A. H. Schroth, Chicago, Ill.
Carl P. Schroeder, Chicago, Ill.
J. M. Stannard, Chicago, Ill.
Fred W. Smith, Dunkirk, N. Y.
John P. Schaffer, Pittsburg, Pa.
Wm. G. Snow, Boston, Mass.
L. W. Stone, Danville, Ill.
Wm. M. Scudder, Chicago, Ill.
H. V. Stoddart, Minneapolis, Minn.
John L. Shay, Chicago, Ill.
A. E. Schad, Chicago, Ill.
L. O. Scovil, Chicago, Ill.
C. W. Sisson, Chicago, Ill.
Alf. Tjersland, Chicago, Ill.
R. S. Thompson, Springfield, Ohio.
Wm. E. Taylor, Toledo, Ohio.
C. T. Tishwick, Chicago, Ill.
Theo. Vladimroff, Chicago, Ill.
Herman J. Warneke, Minneapolis, Minn.
Ralph P. Willis, Springfield, Ohio.
H. R. Willard, Chicago, Ill.
E. Woodbury, Chicago, Ill.
R. A. Widdicombe, Chicago, Ill.
Edwin A. Wray, Chicago, Ill.
L. J. Wing, New York.
Theo. Weinshank, Indianapolis, Ind.
Warren Webster, Camden, N. J.
Robt. H. Walch, M.D., Philadelphia, Pa.
J. Z. Young, Chicago, Ill.
E. H. Younglove, Chicago, Ill.

The first session was called to order by President Gormly Thursday morning, July 19, in the south parlor of the Auditorium Hotel. After Secretary Mackay had called the role and had announced the election of new members (the list appeared in our July issue) the following address was read by the president:

PRESIDENT'S ADDRESS.

Custom has made it the duty of the president to open the meetings of the society with an address. No doubt this is intended to be complimentary to the president, but had he been consulted in this instance it would probably be omitted. This is said with no desire to criticise the programme, for it appears to be excellent. We have assembled to advance the interests of ourselves, our society and the public in general. We are giving our time, and it is better to spend it in the discussion of scentific matters than in listening to a speech from any one. Our purpose will be advanced by thought rather than words. Thought leads to investigation, investigation to experiment, and experiment leads to facts which are invaluable. The facts which we have acquired are our greatest asset. If we cultivate the habit of thought and the spirit of investigation we will advance beyond the phenomenal advancement already made.

One of the greatest pleasures of modern life is to live in a well heated and ventilated house. Another to know that your children are in well ventilated schools. But a few years ago a well heated house was not to be found. Now such buildings are within the reach of all. In a great measure this blessing was brought about by our society. We are the standard bearers of civilization. It has been well said, "The measure of a country's civilization may well be gauged by the manner of heating and ventilating its homes." We know the crude efforts of the Indian to heat his dwelling. We have heard the story from the fathers of history how the Romans heated their dwellings by smoke flues which

ran under their living rooms, permitting the escape of so much gas and smoke that frequently the family adjourned to the open air in order to survive.

Later we know how the heated air was separated from the smoke to a certain extent. To-day many houses are heated in this manner. Your president can well remember when most houses were heated by a stove in each room. Thanks to investigations and experiment on the part of our members, well seconded by manufacturers and by the press, to-day remote hamlets as well as cities are well heated by steam or hot water. It is a source of great pleasure to us that we have materially aided in this advancement. Kindred heating societies are also doing this good work in other lands, but our society was the pioneer. With a generosity unknown in other ages, we gladly spread our knowledge and information to members and nonmembers alike.

Our organization is known and honored wherever civilization has penetrated. I trust our deliberations here will be for betterments which will benefit the whole human race. To return to the immediate work in hand and to dispose of it to the best advantage, it will be necessary for the members to confine their thoughts and remarks strictly to matters on the programme. The programme is long, requiring the best use of our time, and is so varied as to include practically all the different applications of heating and ventilating apparatus attracting your attention at this time. I shall find no pleasure in bringing any member back to the subject or in shutting off debate, but while disposed to be liberal in courtesies must remember that we are a society of engineers and our meetings must be so conducted as to advance its dignity, which is temporarily in my charge. I extend on behalf of the society a cordial invitation to all present who are interested in the programme to take part in the discussions.

As I am unfortunate in not being able to call all by name, I request, for the benefit of the stenographer and the members, that all who speak will first state their names. This is very important. The prestige of our society has secured for its members some courtesies and attention which are shown in the communications which the secretary will read.

Following the reading of the president's address, Secretary Mackay read a communication from the Western Society of Engineers offering the use of its rooms in the Monadnock Block for the society's sessions. Previous arrangements, however, had already been made. Letters of regret were read from A. H. Barker, of Trowbridge, England, Reginald P. Bolton, of New York and C. B. J. Snyder, of New York. In his letter, Mr. Snyder spoke in favor of the formation of local chapters, if properly conducted. A letter was also received from Stewart A. Jellett, of Philadelphia, pointing out dangers that might arise from the formation of local chapters as well as the care that would have to be exercised in forming such chapters. Mr. Jellett's letter helped to shape the discussion that came up later.

A letter was also read containing a request from Rear Admiral Melville, ex-president of the American Society of Mechanical Engineers, for copies of the president's address, the papers and the discussion of topics 3, 4, 7 and 14.

The first paper on the programme was entitled "Heat Losses and Heat Transmission." In the absence of the author, Mr. Walter Jones, of Stourbridge, England, the paper was read by Prof. J. H. Kinealy. It is published herewith in full.

*Heat Losses and Heat Transmission**

By Walter Jones, Stourbridge, England

(Member of the Society)

Heat losses and heat transmission, examined critically and constructively, in the hope of arriving at some data and some simple method of calculation for ascertaining what radiator or pipe surface for hot water will be required to give any required temperature in ordinary buildings.

The want of unanimity, and the conflicting tables and formulæ given by various writers on this subject, afford ample evidence that some effort should be made to obtain results with some approach to uniformity.

The subject is extremely difficult. The members of the heating trade are indebted to several writers for the efforts made to solve it, and as frequent references will be made to authors of considerable repute, it is no carping or critical spirit, but with an earnest desire to ascertain what is wrong, not who is wrong. We may all be right sometimes, but we are not right always, and the infallible man is not yet born.

When we have to prepare a scheme, or an estimate for warming a building, we must first ascertain what are the heat losses, how, why and in what proportion these losses occur, and then provide for

*Read at the Summer Meeting of the American Society of Heating and Ventilating Engineers, Chicago, Ill., July 19-20, 1906.

heat transmission to compensate for the theoretical or actual loss, and thus restore the balance; this would at first appear a very simple matter, but it is not so simple as it looks.

The building may be constructed of brick, timber, stone, concrete, glass or other materials, or a combination of any or all of these materials. The amount of heat lost will depend largely upon the materials used—glass, wall, wood, iron, etc. —each substance requiring a different factor, coefficient or multiple, and the pipe or radiator through which the heat is transmitted should bear some definite proportion to the materials through which the losses occur; this coefficient we will call the surface ratio (S. R.) or the surface required (in superficial feet) of pipe or radiator to provide for the loss per foot super. of glass, wall, timber, sheet iron or other material.

When speaking of the air inside the building, the calculations will be based on cubic feet and the surface ratio (S. R.) of pipe or radiator will be proportioned to the number of cubic feet of air in the buildings, and the number of times the air requires to be changed per hour.

To avoid confusion, let me explain that we are not at present dealing with the difference in temperature between the inside and the outside of the building; this will rquire a separate and distinct calculation. We will first consider what fraction of a foot of radiator or pipe surface will transmit the heat necessary to compensate for the loss of 1 degree Fahr. through the glass, wall or the air contained in the building.

To economize space, and to enable the reader to follow the description and check the calculation, abbreviations are given.

Heat is measured by means of thermometers. The British Standard Unit is the amount of heat required to raise the temperature of one pound of water at 32 degrees Fahr. 1 degree—*i. e.*, from 32 degrees to 33 degrees Fahr.—the letter U being used as the abbreviation for unit.

On the continent of Europe, where the Centigrade thermometer is used, the standard of measurement is the Calorie, or the amount of heat required to raise 1 kilogramme (2.204 pounds) of water 1 degree Cent.—1 degree Cent. being equal to 1.8 degree Fahr.—and units may be converted to calories, or calories to units, as follows:

B. T. U. × .252 = Calories.

Calories × 3.968 = B. T. units.

This introduction will appear to many expert engineers to be somewhat elementary, but heating engineers are not all mathematicians, and in making important calculations it is as essential to have a sound basis as it is to have a good foundation when erecting a lofty building. If I commenced by saying that 84 inches = 1 foot, you would think that I was fooling, and yet if we compare the statements made by various authors on the loss in units per square foot of glass, per degree

ABBREVIATIONS, AND THEIR DEFINITIONS

Co.	Coefficient or multiplier to cover S.R. and T.R. losses
C.C.	Cubic capacity.
C.F.	Cubic feet.
D.	Difference in temperature.
D.D.	Degree difference in temperature.
D.E.	Decimal equivalent.
F.S.R.	Feet super. of radiation.
G.	Glass, feet super.
I.T.	Inside Temperature Fahr.
L.U.	Loss in units by glass, walls, etc.
O.T.	Outside temperature Fahr.
R.	Radiation surface, for equivalent surface of glass, wall, etc.
Rec.	Reciprocal or Divisor to cover S.R. and T. R. losses.
S.H	Spicific heat.,
S.R.	Surface Ratio = feet super. of pipe or radiator, per feet super. of glass, wall, etc.
T.R.	Temp. Ratio = multiplier to cover the difference in temp. only.
U.	Units British Thermal.
U.T.	Units transmitted by Radiator, per foot, per degree, per hour.
U.pF.	Units per foot.
U.pF.pD.	Units per foot per degree difference.
U.pF.pH.	Units per foot per hour.
U.pF.pD.pH.	Units per foot per degree difference per hour.
W.	Wall (exposed) feet super.
W.T.	Water temperature (average).

Loss in units per ft. per deg. ÷ Rad. U.pFt.pD = surface ratio or ft. sup. of pipe or radiator, per ft. sup. of glass wall, etc.

G., W., C.C. } x S.R. = radiation surface (ft. sup.) for equivalent surface of glass, wall, etc.

R. x Tr. = feet super. radiation required to cover all losses.

F.S.R. at a given temp. x D.E. = Ft. sup. Rad. for any required temp.

difference per hour, the difference is over 600 per cent. or equivalent to saying that 84 inches = one foot lineal.

HEAT LOSS CALCULATIONS

The calculations in this paper will refer principally to the losses by glass, by exposed walls and by the air in the rooms (cubic capacity) and the leakage through the walls, doors or up the chimney or ventilating shaft, as no rule for ascertaining the required amount of heating surface will give satisfactory results unless these three factors are duly considered.

The authorities quoted in Table I showing the surface losses, or loss of heat from the glass, the walls and the air in the building (*i. e.*, the cubic capacity) do not give the figures exactly as shown; these have been reduced to one standard for convenience of comparison, and so that the discrepancies may be more readily appreciated.

ful. One of the first and most important problems for heating engineers to decide is an approach to uniformity, by adopting some definite data as to the actual surface losses by glass, wall, etc., and the actual heat transmission from the pipe or radiator, that will provide for the surface losses of glass, wall, or other material.

Now, so far as I have been able to ascertain, the tables by Professor Rietschel, of Germany, and of Chas. F. Hauss, Antwerp, Belgium, compiled after many exhaustive tests, appear to be the most reliable yet published, and these are converted from the metric or calories per square meter, into B. T. units per square foot, for convenience of reference.

Suppose we adopt Professor Rietschel's coefficient for heat losses; and the heat transmission from radiators as 1.8 units per foot super. per degree difference, per hour, which from a single column radiator or plain pipe will be found fairly accurate,

TABLE 1.

Showing the variations in the HEAT LOSSES given by different authors.		Loss in Units per Foot, per Degree, per Hour.		
Authority.	Page.	Glass, Sq. Feet.	Wall. Sq. Feet.	Capacity, Cubic Feet.
Box (T.), on "Heat"	222.233 Greenhouse.	.306 .391 .40 .41		
	220 Windows.	.504 .515 .53		
Cox (A.), "Water Circulation"	81 Greenhouse Windows.	1.05 1.57	.157	.020
Keith (J.), "History of Labor"	66	1.125	.225	
Baldwin (W. J.), "Hot Water Heating from Hood."	86, 90, 91	1.53 2.248	.153	
Carpenter (Professor), "Heating and Ventilation"	59, 205, 209	1.	.25	.018
Dye (F. Hood) on "Warming"	239	1.5		
Bennett (G. G.), "Domestic Engineering" Mar., '06	12	.543	.223	.0205
Allen (J. R.), "Heating and Ventilation."		Wall 8" thick.		
(German)	22	.776	.46	.018
(Carpenter)	23	1.	.25	.018
		Wall 10" thick.		
Rietschel, Germany	Windows	1.0865	.35	.019
	Skylight	1.156		
Hauss (C. F.), Antwerp	Windows	1.	.34	.019
	Skylight	1.06		
		Wall 9" thick.		
Wallas (J. C.), London		1.09	.47	
Jones (Walter), "Rule D."	10	1.28	.428	0.25
Allowing over Prof. Reitschels for factor of safety		16%	22%	35%
The reason for this is given on page 9.				
Difference between the highest and the lowest		= 634%	213%	80%

Mr. Allen	gives	2	ft.	super.	of	wall	As equivalent to 1 ft. super. of glass, showing a difference of 400%.
Mr. Bennett	"	2½	"	"	"	"	
Prof. Rietschel	"	3	"	"	"	"	
Prof. Carpenter	"	4	"	"	"	"	
Mr. Keith	"	5	"	"	"	"	
Mr. Baldwin	"	10	"	"	"	"	

The wide divergence of opinion on the first or elementary basis of providing for a heating installation is not only interesting; in my opinion it is humiliating. Can we wonder that heating engineers often fail to get the results they strive for? The marvel is that they are ever successful.

we then proceed to find the fractional part of a square foot of radiator that will make good the various losses as under:

Formula 1. L. U. ÷ U. T. = S. R. (Surface ratio of pipe or radiator.)

Formula 2. G. (feet super. × S. R. = R. (Rad. surface.)

Example 1.

S. R.

Any given surface of glass × .6 = R. (Radiation surface) for given surface of glass.

Any given surface of wall × .2 = R. (Radiation surface) for given surface of wall.

Any given cubic contents × .01 = R. (Radiation surface) for one change of air.

Let me repeat that up to the present we have been considering the relative heat losses, and heat transmissions due to surface only, from which we find that one foot of glass will require .6 feet of pipe for each degree difference in temperature.

LOSSES DUE TO DIFFERENCE IN TEMPERATURE

We will now consider the second equation, which deals with the losses due to the difference in temperature, as the manner in which these two equations have been mixed is most confusing; some of the authorities quoted in Table I. apparently assume that the glass loses the same amount of heat per square foot as the radiator transmits per square foot, whereas the relative proportion is as 108 is to 180, or a difference of 66 per cent. Take the following sentence: "The room is to be kept at 70 degrees, then the steam pipe 228 degrees — 70 degrees = 158 degrees difference in temperature; each square foot of heating surface will give to the air in the room 158 heat units," whereas it should read, each square foot of heating surface will transmit 158 degrees × 1.8 degrees = 284 heat units.

So far as I can understand the calculation of G. G. Bennett, as shown in Table I., appears to have been taken on this erroneous basis.

DIFFERENCE IN TEMPERATURE

The method adopted by all authorities appears to be practically the same, viz.:

Formula 3. $\frac{\text{I.T.} - \text{O.T.}}{\text{W.T.} - \text{I.T.}} = \text{T.R.}$ Multiplier to cover losses due to difference in temperature only.

Example 2. For 70° inside, 0° outside, and water 170°.

$$\frac{70 - 0}{170 - 70} = \frac{70}{100} = \text{T.R.} \quad .7$$

or multiplier to cover losses due to difference in temperature.

This appears to be a reasonable and scientific method, providing the losses for each degree difference in temperature are the same at all temperatures, whether the difference is one degree only, or 100 degrees, but I hope to show that the losses do not bear the same relative proportions under the extreme conditions mentioned.

I find that in the tables prepared by Professor Rietschel, C. F. Hauss, J. H. Mills and others, the coefficients or multiples for differences in temperature of 50 degrees, 60 degrees or 70 degrees are 50, 60 or 70 times the coefficient given for 1

TABLE 2.

LOSS IN B. T. U. PER SQUARE FOOT PER DEGREE DIFFERENCE PER HOUR.

	Rietschel.	Hauss.
Glass surface (single) per square foot	1.0865	1.0
" double glazed	.47	.46
Skylights single	1.156	1.06
" double glazed	.48	.48
Thick.		
Walls (outside) 4½ inches	.49	.48
" " 10 "	.35	.34
" " 15 "	.27	.26
" " 20 "	.22	.22
" " 25 "	.18	.18
" " 30 "	.15	.16
" " 35 "	.13	.13
" " 40 "	.12	.12
Air, one change per hour per cubic foot	.019	.019
" two changes = .019 × 2 =	.038	.038
" three " = .019 × 3 =	.057	.057

TABLE 3.

	1	2	3
	Loss in Units per F. per D. per hour	Units transmitted by Radiator per F. per D. per hour	Surface ratio of pipe.
Glass in windows	1.08 +	1.8 =	.6 per foot super. of glass.
Wall 10" thick	.35 +	1.8 =	.2 per foot of wall.
Air cubic capacity	.019 +	1.8 =	.01 per cubic foot for one change per hour.
" " " 2 changes.	.038 +	1.8 =	.02 two changes per hour.
" " " 3 "	.057 +	1.8 =	.03 changes per hour.

degree only, which appears to me to be erroneous, and will be referred to later.

I described Formula 1) the method for ascertaining the S. R. (surface ratio); in Formula 2, the method for obtaining R. (radiator surface) for a given surface of glass, etc., and in Formula 3, the method for obtaining T. R. to cover the losses due to the difference in temperature.

I will now give Formulas 4 to 8, showing how the necessary calculations may be completed.

Given the L. U. (loss in units) to find the coefficient (or multiplier) or the Rec. (reciprocal or divisor) to cover the S. R. and T. R. losses.

Formula 4. $\frac{\text{L. U.} \times \text{T. R.}}{\text{U. T.}} = \text{Co.}$ (multiplier to cover S. R. and T. R. losses.)

Formula 5. The unit $1 \div \text{Co.} = \text{Rec.}$ (Divisor to cover S. R. and T. R. losses.)

Given the Co. (multiplier), to find the L. U.

Formula 6. $\frac{\text{C.} \times \text{U. T.}}{\text{T. R.}} = \text{L. U.}$ (Loss in units.)

Given the Rec. (divisor) to find the L. U.

Formula 7. $\frac{1 \times \text{U. T.}}{\text{Rec.} \times \text{T. R.}} = \text{L. U.}$ (Loss in units.)

Formula 8. Or the unit $1 \div \text{Rec.} = \text{Co.} \div \text{T. R.} = \text{S. R.} \times \text{U. T.} = \text{L. U.}$

Some examples of the use of these formulas are given in Table 4.

Example of Formulas 7 and 8:

If 2.57 is the Rec. (divisor) for glass, what would be the L. U.?

TABLE 4.

1.	2. L. U.	3. U. T.	4. S. R.	5. T. R.	6. Co.	7.	8. Rec.	9.
Cox.								
Glass	1.57	+ 1.8 = .87	× .7 = .609	& $\frac{5}{8}$	= 1.64			for Glass.
Wall	.157	+ 1.8 = .087	× .7 = .0609	& $\frac{5}{8}\frac{5}{8}$	= 16.4			for Wall.
C.C.	.020	+ 1.8 = .0114	× .7 = .00798	& $\frac{5}{8}\frac{5}{8}$	= 125.			for C. C.
Carpenter								
G.	1	+ 1.8 = .555	× .7 = .3885		= 2.57			" G.
W.	.25	+ 1.8 = .14	× .7 = .098		= 10.			" W.
C.C.	.018	+ 1.8 = .01	× .7 = .007		= 142.			" C. C.
G. G. Bennett assumes that Rad. transmits 1 U. per F. per D per H instead of 1.8 Units as taken by other authorities.								
G.	543	+ 1 = .543	× .7 = .38	=			2.63	" G.
W.	.223	+ 1 = .223	× .7 = .156	=			6.4	" W.
C.C.	.0205	+ 1 = .0205	× .7 = .01435	=			70.	" C. C.
Rietschel								
G.	1.085	+ 1.8 = .6	× .7 = .42	=			2.38	" G.
W.	.35	+ 1.8 = .2	× .7 = .14	=			7.14	" W.
C.C.	.019	+ 1.8 = .01	× .7 = .007	=			142.	" C. C.
Hauss, C. F.								
G.	1.	+ 1.8 = .555	× .7 = .3885	=			2.57	" G.
W.	.34	+ 1.8 = .19	× .7 = .133	=			7.5	" W.
C.C.	.019	+ 1.8 = .01	× .7 = .007	=			142.	" C. C.
W. Jones								
G.*	1.28	+ 1.8 = .71	× .7 = .497	=			2.	* " G.
W.*	.428	+ 1.8 = .238	× .7 = .166	=			6.	* " W.
C.C.*	.025	+ 1.8 = .014	× .7 = .01	=			100.	* " C. C.

*In the above formulas, as on page 7, and in Rule D, page 8, I have added to the L. U. given by Professor Rietschel 16% for Glass, 22 % for Wall, and 35% for air, and I do not think this will be any too much.

Some engineers add 5, 10, 20, up to 100% to their calculations as a factor of safety, which ought not to be necessary. I have seen it stated that the loss through walls and windows is equal to three changes of air per hour without any other provision for ventilation, and although this may be an exaggeration, the loss is much greater than is generally supposed.

I have met with hundreds of cases where the guaranteed temperature could not be obtained, until from 50% to 100% of radiation had been added, and I strongly advocate the putting in of sufficient radiation to obtain the results easily, and if this can be done with water at 165° instead of 170°, none will have cause for complaint.

Unit. U. T.

$\frac{1 \times 1.8}{2.57 \times .7} = \frac{1.80}{1.79}$ = per cent. loss in units per F. per D. per hour.

R.ec T. R.

The following Co. (multiplier) and Rec. (divisors) are calculated from Formulas No. 4 to 8, using T. R. as Exam. 2.

RULE D

FOR ORDINARY BUILDINGS (NOT HORTICULTURAL)

To obtain 70 degrees inside when 0 degrees outside, with water 170 degrees.

Glass (ft. super.)	÷ 2	=Feet super. of radiation for rooms under 5,000 cubic feet.
Wall (ft. super. exposed	÷ 6	
Cubic capacity (in feet)	÷ 90	

As the rooms increase in size the proportion of glass and wall to the cubic capacity is relatively smaller, the walls are thicker and the losses are proportionately less.

To provide for this, the divisors for all the glass and for exposed walls may be taken as constants, but the divisor for C. C. will require some elasticity; the exact divisor can only be determined by results obtained from actual tests, but I estimate they would be approximately as follows:

Cubic	capacity	÷	90	for	rooms	under 5000	cubic feet.
"	"	÷	100	"	"	5,000 to 25,000	" "
"	"	÷	110	"	"	25,000 to 50,000	" "
"	"	÷	120	"	"	50,000 to 100,000	" "
"	"	÷	130	"	"	100,000 and upwards	cu. ft.

The above rule is simple, it is short and quick, and will, I think, be found more reliable than many of the complicated formulas that are published; it will tend to reduce the number of errors by miscalculation, and should it be found necessary to make any modifications this can readily be done from the formulas already given.

Some objection may be taken to Rule D because the ceilings or roof are not taken into consideration, but the allowances made and described at the foot of Table 1, and following Table 4, will, I think, provide for this, and I have used a similar rule for British conditions for several years with very satisfactory results.

Comparisons of formulas to ascertain at one calculation the radiation required to give 70 degrees inside when 0 degrees out, and water 170 degrees, in a room with 40 feet glass, 600 feet wall and 4,000 cubic feet.

I think the discrepancies already referred to prove that our formulas need some revision if we are to obtain satisfactory results.

VARIATIONS IN METHODS OF CALCULATION FOR HEATING CHURCHES

Speaking of churches, an English author says: "It is not necessary to calculate on a greater interior height than 16 feet; a 2-inch pipe carried along each side, or around the church about 16 feet above the floor level, deals with the upper strata of air," whereas Mr. C. F. Hauss says:

Add	3⅓%	where the height of room exceeds 13 feet.
	6⅔%	where the height of room exceeds 15 feet.
	10 %	where the height of room exceeds 18 feet.

I would simply ask, "When experts differ who is to decide?" So far as my own personal experience goes, I should calculate the whole cubic capacity, and I should not add either 3 per cent. or 10 per cent. simply because of the height of the room.

When a stated temperature is required, 30 degrees to 60 degrees as in England, or 0 degrees to 70 degrees as in America, we certainly ought to get within 10 per cent. of the surface required, whatever formula is used, but in extreme cases, where unusual temperatures are demanded, such as 90 degrees to 100 degrees, a variation of 20 per cent. may be excusable; at present, a difference of from 100 per cent. to 200 per cent. is not at all uncommon.

I have puzzled over this problem for many years, and have brought the matter before the British Institution of Heating and Ventilating Engineers, but it is still, so far as I know, an unsolved problem.

TEMPERATURE RATIO LOSSES NOT THE SAME AT ALL TEMPERATURES

All the tables prepared by Professors Carpenter, Rietschel, Hauss, Mills, and others, that have come under my notice, assume that the T. R. losses are practically the same at all temperatures; the losses for a difference in temperature of 70 degrees are given as 70 times the loss for 1 degree.

If a radiator transmits 1.8 units per square foot for 1 degree difference in temperature, does it transmit 180 units for 100 degrees difference in temperature?

If glass loses 1 unit per foot for 1 degree difference, does it lose 100 units for 100 degrees difference? I think the loss is greater under the latter conditions.

If a wall loses .35 units per foot for 1 degree difference, does it lose 35 units for 100 degrees difference?

I think it loses much more. If not, how are we to account for the enormous increase of surface (proportionately) to obtain the higher temperatures?

I have stated that the basis of our calculations was at fault somewhere, and in my opinion the only way in which this problem can be solved will be by a large number of actual tests, in rooms having considerable variations in size, materials of construction and covering a wide range of temperatures, the results being carefully plotted on a diagram, and some simple rules formulated from the results thus obtained.

NO FORMULAS FOR PLANTS TO SUPPLY EXTREME TEMPERATURES

In my experience as a heating engineer I am frequently asked for extreme temperatures to meet some special requirement, and have not yet met with reliable data for the purpose. I have in many

cases had to formulate my own data from experiments. Here is an example that is rather exceptional. A client wishes to know if I can supply a hot-water plant that will keep wax in a liquid state at 400 degrees Fahr. I have promised to do it. Do you know of any printed formula for such a problem as this? I don't.

Let me give two ordinary examples, and I shall be glad if some of the members of our society will work out by any published rule or formula what surface they consider necessary to give the stated temperatures before referring to the answer given to your secretary, and I think they will be surprised at the result. It will be more interesting and profitable than any guessing competition.

Example No. 3 relates to a room on the first floor, about 70 feet long by 32 feet wide, plastered ceiling reaching half way up the slate roof, and the four walls outer, or exposed.

The rooms underneath were warmed to 60 degrees, so there would be no appreciable loss through the floors. The exposures were:

Glass in windows	50 feet super
Walls exposed	470 feet super
Matchboard ceiling	700 feet super
Cubic capacity (ventilators closed)	4,850 cubic feet

Test No. 22. Water temperature (average) 180 degrees. Inside temperature 100 degrees, outside 40 degrees Fahr. Four-inch pipes were distributed over the floor 6 inches from the floor level. How many feet super of radiation were required to obtain the results given in Test 22?

The tests were carefully taken for several days, and the figures given to your secretary may be accepted as reliable.

I shall be glad to hear what the American heating engineers make of this, and will simply state that engineers of considerable repute in Great Britain, Germany and Hungary did not get within 100 per cent. of the actual surface required, which shows that the usual formulas need some revision.

Example No. 4 was a room on the ground floor for drying timber or lumber, a room above was kept at 60 degrees, and the floor above was laid with tongued and grooved 1⅛-inch boards, the ceiling under the joists being matchboarded.

Glass (half windows, and half skylight)	370 feet super
Walls exposed (four sides of room)	1,530 feet super
Ceiling, lath and plaster	2,130 feet super
Cubic capacity (ventilators and windows closed)	23,500 cubic feet

Test 18. Water temperature (average) was 161 degrees. Inside temperature 76 degrees, and outside 30 degrees Fahr.

Test 19. Water temperature (average) was 161 degrees. Inside temperature 87 degrees, and outside 42 degrees Fahr.

Test. 20. Water temperature (average) was 157 degrees. Inside temperature 96 degrees, and outside 48 degrees Fahr.

Six rows of 3-inch pipes, one above another, were used wholly or partially during tests. How many feet super were required respectively for Tests 18, 19 and 20?

TABLE 5.

1.	2.	3.		4. *Rec.		5		6
A. Cox	Glass	40 Ft.	+	1.64	=	24	}	92 Ft. Super Rad.
	Wall	600	+	16.4	=	36		
	C. C.	4,000	+	125.	=	32		
Professor Carpenter	Glass	40 Ft.	+	2.6	=	15	}	103 Ft. Super Rad.
	Wall	600	+	10.	=	60		
	C. C.	4,000	+	140.	=	28		
G. G. Bennett	Glass	40 Ft.	+	2.63	=	15	}	165 Ft. Super Rad.
	Wall	600	+	6.4	=	93		
	C. C.	4,000	+	70.	=	57		
Professor Rietschel	Glass	40 Ft.	+	2.38	=	16	}	128 Ft. Super Rad.
	Wall	600	+	7.14	=	84		
	C. C.	4,000	+	140.	=	28		
Hauss, C. F.	Glass	40 Ft.	+	2.57	=	15	}	123 Ft. Super Rad.
	Wall	600	+	7.5	=	87		
	C. C.	4,000	+	140.	=	28		
W. Jones. Rule D	Glass	40 Ft.	+	2.	=	20	}	164 Ft. Super Rad.
	Wall	600	+	6.	=	100		
	C. C.	4,000	+	90.	=	44		

The results obtained in Table 5 show variations of 76% for one, and the same room, which can scarcely be considered satisfactory.

*** The Multipliers (Co.) in col. 6, Table 4, may be used instead of the Divisors (Rec.) given in col. 8. The result will be the same.**

CHIEF CAUSE OF THE DISCREPANCIES

I will now endeavor to point out what appears to me to be the chief cause of the discrepancies to which I have referred,

TABLE 6.

TEMPERATURE RATIOS, OR MULTIPLIERS TO COVER LOSSES DUE TO THE DIFFERENCE IN TEMPERATURE ONLY.

Inside Temp.	Outside Temperatures, and Water 170° Fahr.										
	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°
40°	.307	.269	.230	.192	.153	.115	.077	.038	—	—	—
45°	.36	.32	.28	.24	.20	.16	.12	.08	.04	—	—
50°	.416	.375	.333	.291	.25	.208	.166	.125	.083	.041	—
55°	.478	.434	.391	.347	.304	.260	.217	.173	.130	.087	.043
60°	.541	.5	.454	.409	.363	.318	.272	.227	.181	.136	.090
65°	.619	.571	.523	.476	.427	.381	.333	.276	.238	.190	.142
70°	.7	. 65	.6	.55	.5	.45	.4	.35	.3	.25	.2
75°	.789	.736	.684	.631	.579	.526	.473	.421	.368	.315	.263
80°	.888	.833	.777	.722	.666	.611	.555	.5	.444	.388	.333
85°	1.	.941	.882	.823	.764	.705	.647	.588	.529	.470	.411
90°	1.125	1.06	1.	.937	.875	.812	.75	.687	.625	.562	.5
100°	1.428	1.354	1.285	1.214	1.142	1.07	1.	.928	.854	.785	.714

NOTE.—The T. R. .272, under the Water Temperature 170°, Inside Temperature 60°, and Outside 30°, will be frequently referred to as **UNITY**, these temperatures being adopted as a moderately fair basis for the English climate.

and will ask you to study carefully Tables 6 and 7.

The temperature ratios (T. R.) are calculated as follows, and are tabulated for convenience of reference:

$$\frac{\text{I. T.} - \text{O. T.}}{\text{W. T.} - \text{I. T.}} = \frac{60 - 30}{170 - 60} = \frac{30}{110} = .272$$

Temperature Ratio for 60° Inside, 30° Outside, and Water 170°.

Please notice the summary of the percentage of increase in the temperature ratios above, as shown in Table 7.

I wish to call special attention to this table, because although the figures are approximate only, and would be liable to some variation according to the size of the rooms and the materials used in construction, it gives a clear indication why the radiation provided to cover the T. R. losses are altogether inadequate.

TABLE 7.

FOR ORDINARY BUILDINGS, ROOMS UNDER 4,000 CUBIC FEET THE APPROXIMATE RADIATION TO GIVE.

1. Outside.	2. Inside.	3. Ft. super radiation per 1000 C. feet.	4. Diff. in temperature.	5. Ft. super radiation.
From 30° to	60° requires	15 +	30° —	= .5 per Deg. diff.
" 30° "	70° "	23 +	40° —	= .57 "
" 30° "	80° "	38 +	50° —	= .76 "
" 30° "	90° "	65 +	60° —	=1.08 "
" 30° "	100° "	112 +	70° —	=1.06 "
Total increase per cent.	66%	646%	133%	=220% "

FOR GREENHOUSES UNDER 4,000 CUBIC FEET THE APPROXIMATE RADIATION REQUIRED TO GIVE.

From 30° to	60° requires	65 +	30° —	=2. per Deg. diff.
" 30° "	70° "	95 +	40° —	=2.37 "
" 30° "	80° "	130 +	50° —	=2.60 "
" 30° "	90° "	178 +	60° —	=2.96 "
" 30° "	100° "	238 +	70° —	=3.4 "
Total increase per cent.	66%	266%	133%	=70% "

SUMMARY OF THE TEMPERATURE RATIOS SHOWN IN TABLE 6 WITH WATER 170°.

		T. R.		F. S. R.
From 30° to	60° requires	.272 +	30° —	= .00906 "
" 30° "	70° "	.4 +	40° —	= .010 "
" 30° "	80° "	.555 +	50° —	= .011 "
" 30° "	90° "	.75 +	60° —	= .0125 "
" 30° "	100° "	1.0 +	70° —	= .01428 "
Total increase per cent.	66%	267%	133%	=57.6% "

In Col. 3, the T. R. units transmitted increase 267 per cent. only, against 640 per cent. for the radiation required.

In Col. 5, the F. S. R. increase provided is 57.6 per cent. only, against 220 per cent. for the radiation required.

I do not give these figures as absolutely correct, although I believe they are not far wrong; I do not suggest that this enormous difference is all due to the temperature ratio losses; the surface losses probably vary with the extreme differences in temperature—i. e., the surface value of one foot of radiation may not bear the same relative proportion to one foot of glass, or wall, when 80 degrees difference in temperature, as it would when 5 degrees difference only.

Whether this opinion be correct or not, I am strongly of the opinion that it will be better to accept the surface losses as constant at all temperatures, and give whatever elasticity is necessary to the temperature ratios, otherwise the factors or calculations will lead to endless confusion.

The point I wish to emphasize is that it would be extremely inconvenient to be compelled to use a different factor for each substance, and for every degree (or for every 5 degrees) difference in temperature, either in the building or in the water, whereas it would be a great convenience and much simpler to use two factors as constants, such as a divisor of 2 for glass and 6 for wall; and an elastic divisor for the cubic capacity that would compensate for the varying thickness of the walls, and for the larger volume of air (proportionately) to the wall or other cooling surfaces; the result thus obtained for stated temperatures, such as 70 degrees inside, 0 degrees outside, and water 170 degrees to be called unity. Another table of factors, called D. E. (decimal equivalents), could then be formulated to cover a wide range of temperatures, inside or outside of the building. I have given much thought and study to this subject, and can think of no better plan, but if any of our members can suggest a simpler or better method I shall give it my careful consideration and hearty support.

When I commenced this paper it was my intention to give a diagram showing the approximate actual losses, as against the theoretical T. R. losses, and a table of Dec. Equivalents with multipliers to obtain the radiation required for various temperatures, but the paper is already sufficiently long, and I have no data from actual tests with zero temperatures available to do this with approximately accurate results.

If one of the American members of our society will take up this subject and communicate with me, I will send him the diagram already prepared, so that he may put it to the test. It will mean some time and trouble, but the results will more than justify it.

DISCUSSION.

MR. KINEALY: In table 1, page 4, I notice that the author, Prof. Allen, is quoted as saying that the loss in heat units per foot, per degree per hour, given in column No. 3, is .776 for a wall 8 inches thick. That is supposed to be taken from some German author. If Prof. Allen were here, I should like to have him say whether or not that is the proper and correct quotation. It appears to me to be similar to a mistake that Mr. Wolfe made in New York some years ago when, in a lecture before the Franklin Institute, in Philadelphia, he made the statement that the heat losses per square foot per degree difference in temperature per hour was about .8, I think. Then on page 7, the first paragraph, the author says, "I find that in the tables prepared by Prof. Rietschel, C. F. Hauss, J. H. Mills and others, the co-efficient of multiples for differences in temperature of 50, 60 or 70 degrees are 50, 60 or 70 times the co-efficient given for one degree only, which appears to me to be erroneous and will be referred to later." In reading these authors I think that the writer has failed to bear in mind that Prof. Reitschel, Mr. Hauss and Mr. Mills, when making the statement he ascribes to them, really meant that that was for average conditions, when the difference between the inside and outside temperature is about 70 degrees. None of these men would for an instant say that the loss for a difference of temperature of one degree was only one-seventieth of the loss for a difference of temperature of 70 degrees, but in order to make the calculations of the engineers simple, that is what they state, that where the difference between the inside and outside temperature is in the neighborhood of 70 degrees, possibly 60 or 70 or even 80 degrees, that the loss per degree difference in that case is so much. Prof. Reitschel—I am very familiar with his writings—very carefully points out that where there is a difference in temperature inside and outside that is large, the heat loss is greater than where the difference is small, but for ordinary conditions, he said that we may assume that the loss per degree is so much. In table 5, I understand there is an error in column 4, opposite Prof. Reitschel's name. I am told that 140 should be 142. In table 7, column 5, you will notice the figures 1.06. I think they should be 1.60.

I find the paper exceedingly interesting. In ordinary work, we cannot go into the small differences which undoubtedly exist. For instance, suppose we have a room in which we are going to put 40 square feet of radiating surface. Now it is useless to talk about adding 3 per cent. to that because we have not calculated out 40 square feet within 3

per cent. Three per cent. of 40 would be about 1¼. Thus many of the points which the author presents here, it seems to me we might well afford to ignore in our work.

MR. THOMPSON: I presume the point made just now is correct as to most authorities, but I believe the authorities have led many of us astray because of the understanding that tables mean exactly what they say, that is in regard to radiation per degree difference. It ought to take just twice as much heat to heat to 70 degrees when the thermometer outside is at zero, as it does when the outside temperature is 35 degrees, but I know, and you do too, that it takes more than twice as much; the ratio is not the same by a great deal.

I had an opportunity of ascertaining that fact by testing apparatus using natural gas, where you can tell exactly the amount of heat you are using. I found that at zero, it takes a great deal more than twice as much than it does at 35 degrees. It seems to me there is a scientific explanation of this fact. Loss of heat from a building is due to either of two causes, radiation or abstraction of heat by the air in the building. Now by increasing the difference in temperature you produce a current of air on the outside of the building which will more rapidly abstract the heat. The higher the temperature of the heating surface, the more rapid will be movement of air against the wall. Everybody is familiar with the fact that it takes a great deal more heat to maintain the temperature in a room when there is wind blowing against it than it does on a still day, because the wind is constantly removing the heated layer of air and furnishing cold air to abstract the heat. Another thing that makes a large difference is the matter of leakage. Leakage is a more important matter than is generally considered. The amount of leakage that goes through a plastered wall is enormous. You increase the temperature and you increase the intake of cold air by leakage and the outlet of heated air by leakage.

MR. DONNELLY: I should like to know whether or not we have lower temperatures or higher temperatures at the time of high wind velocity. We may have a temperature in New York of 10 or 20 degrees above zero with apparent little wind velocity, while other localities have low temperatures accompanied by very high wind velocity, and in my opinion, the leakage of air in the windy side of the building is increased to a very large extent by high wind velocities. Unless we know the velocity of the wind and the wind pressure due to that velocity upon the windward side, it is very difficult to tell what the air leakage into the building at that time would be.

MR. LEWIS: I should like to know if the other members agree with me in this, whether in proportion to the amount of radiation to be used in heating a room the cubic contents of that room, as cubic contents literally have anything to do with the amount of radiation required. It seems to me that we do not take into account the losses through leakage, open doors and floors and from the ceiling or through the ceiling. We call that cubic capacity, but the still air irrespective of the amount required for ventilation has nothing to do with the amount of radiation necessary to supply the losses.

MR. JAMES MACKAY: Has anyone any data as to the amount of radiation that is necessary or the ratio that is necessary to increase the temperature of a given room, say 10 degrees? Take a room, for instance, where you have established the amount of radiation that is necessary to heat that room to 70 degrees. We will suppose it becomes necessary to raise that temperature to 80 degrees. How much radiation or what ratio of increase would be employed? The ratios that have been given in text books are almost a fixed quantity, but are they not erroneous and should we not increase them much more than we usually do? I have found that in increasing the heating surface in a room 25 per cent. barely raised the temperature 10 degrees.

MR. LEWIS: I have always found that when we were required to raise the temperature of a room 10 or 20 degrees, we would increase the radiating surface much more than one would imagine.

SECRETARY MACKAY: It seems to me that it would be well if some members who wished to would take the time to verify or change the figures presented by Mr. Jones and send in a written discussion on the paper in time to be embodied in our proceedings. I have had occasion to raise the temperature above 70 degrees in operating rooms, hospitals drying rooms, etc., and I have found that it takes approximately 50 per cent. more radiation whether steam or hot water is used to raise the temperature 10. degrees. I have raised the temperature from 70 to 80 and 90 and up to 110 degrees by adding, for each 10 degrees, 50 per cent. to the radiation required for 70 degrees.

MR. WIDDICOMBE: By using Mr. Jones' book with the answers in it, I have figured back from that and by taking Mr. Allen's coefficients, I worked our problems Nos. 18 and 19 correctly. With the coefficient I found in Carpenter, I worked out No. 20 being 10 per cent. out of the way. I was 100 per cent. out of the way on No. 4 based on Carpenter. Of course if I had taken Carpenter at the start I would have been further away.

TOPIC NO. I.

The Comparative Relation Between the Completeness of Air Removal and the Efficiency of Steam Radiators.

DISCUSSION.

MR. DONNELLY: I have suggested this as a topic of discussion instead of attempting to write a paper upon it, for the all sufficient reason that it is a subject about which I know absolutely nothing. I have searched through all available sources in an endeavor to obtain information upon it from others and have not secured anything that was satisfactory.

I am of the opinion that the varying results that have been obtained by tests upon different styles of radiating surfaces and radiators composed of different materials have been caused to a greater extent than we have perhaps supposed by a variation in the completeness of air removal. This may be the correct way to test radiators in order to show the total advantage of one style over another, but it would be ineresting to know how much to charge up to this factor and endeavor to correct it by better air removal.

It is probable that there is a difference in the efficiency of radiators circulated upon the one or the two pipe system by reason of the difference in air removal and perhaps an increased efficiency in the use of the hot water type of radiator when used on steam with the steam connection at the top and the return at the bottom, same or opposite end. There may be a difference between those methods of circulation which employ an air valve upon a loop of the radiator to extract air and those which have an air valve upon the return, or those which conduct the air down the return to be afterward extracted at a common point of discharge.

The greater efficiency of wall radiation over pipe coils, if it really exists, as it seems to do, might be materially changed by a study of this subject which would lead to a better means of air removal from the coils. It is very difficult to get a good air removal from a pipe coil built with headers, and return bend coils have often been preferred because of this. Too high a velocity of entrance to the header causes the steam to skip the first pipe, and this has sometimes led to the use of headers of larger size run than the pipe connections and to the use of some form of baffle plate inside the header. It is also difficult to properly locate the air valve. It is often placed on the top of the return header, where it certainly does not take the air out of the lower pipes. When it is placed upon the return pipe better results are usually produced, though it very often floods with water in that location. Wherever it is placed it cannot act properly if the coil takes steam from the return end, and on account of the fact that coils are usually built rather long they are very apt to do this.

Certainly, a greater efficiency of air removal over the methods now employed, or a type of surface better adapted to correct air removal, would help hot blast radiation.

Air at varying temperatures and pressures has a varying capacity for the absorption of moisture, and steam likewise must have a certain capacity for the absorption of air before materially affecting the efficency of the radiator. A certain proportion of air we know must be present before it can be detected by a cold spot on the radiator; yet its efficiency may fall materially before this can be done, but until it may be found in this way we usually consider that we have complete air removal.

A vessel consisting of a single body portion, of reasonable area in cross section, with a steam connection at the top and a discharge from the bottom for both water and air, with an admittance of steam at a comparatively low velocity, would seem the most favorable for complete air removal. One divided into two body portions, with a steam and return connection at the bottom and air removal some distance above, would seem an unfavorable design.

MR. KINEALY: This is a most interesting topic, but it is extremely difficult, in fact I think it is impossible, to give any exact ratio. I have made tests where I have taken the air out of the radiator and created in it a vacuum of 20 inches, then turned on the steam and determined by a number of very careful tests the amount of condensation per hour with this radiator, keeping the condition of the air surrounding the radiator always the same for the different tests. Then I have taken the same radiator and after allowing it to cool down have filled it with air and then created in it a vacuum of 15 inches and determined the condensation after having turned the steam on, the steam pressure being the same in both cases, and the air pressure being the same in both cases. The radiator was in a room into which no one could get, and a thermometer was rigged up so that it could be swung around to a window and read, so that there could be no movement of air other than that strictly due to the radiator. No one could walk around the radiator and no air currents from the outside could strike the radiator. I have tested this same radiator with a vacuum of 10 inches, or 5 inches, or 4 inches, and I invariably found that with the higher initial vacuum, that is, the more perfect air removal, I got the better efficiency of condensation from the radiator. But while it might be a certain amount in one radiator it would not be the same amount in another radiator; that I found by experiment. So that as I

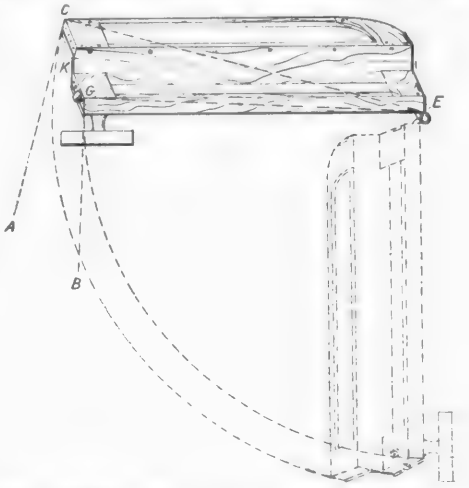
say, I don't think it is possible for us at present to say whether the increase, if we start with a vacuum of 20 inches, would be 10 per cent. or 5 per cent., even if we started with no vacuum at all. The degree to which we free our radiator of air will effect very materially the efficiency of the radiator, I don't think there is any question about that.

MR. BISHOP: The efficiency of a radiator, it seems to me, is in getting the greatest amount of heat when there is the greatest demand and the greatest demand for the heating season is only about one-fiftieth of that period. It seems to me that engineers should do more to make heating installations more satisfactory during forty-nine-fiftieths of the year than during the fiftieth portion of the year. We should get sufficient radiation to take care of the temperature and satisfactorily warm a room at the minimum outside temperature and then regulate the admission of steam to the radiator so that it will be equally saisfactory at other times. During the last 3 or 4 years we have made a great many experiments with top connecting radiators, using them with no air vents at all on the radiators and no return valves on the outlet in a two-pipe system. There was the usual small air pipe, half an inch in size and the valve admitting the steam had a graduated opening so that the occupant of the room could regulate the heating of the radiator. If the day was mild and he only wanted to heat one-tenth of the radiator, he can turn the valve on a graduated point to one-tenth and the steam would flow from the top of the radiator one-tenth of the height and then the water would accumulate, flowing out through the return. If the air was cooler and more radiation was wanted, the valve was opened further, these various graduations being shown on the graduation valve. When the valve was wide open, the steam left the radiator at the return side. The question of graduating these valves has been a hard one, as it is necessary to go into the question of the amount of steam condensed per square foot per hour under certain conditions, assuming some average normal condition.

MR. HALE: I am especially interested in this subject in connection with the removal of air by a vacuum. I have been unable in tests to get the exact percentage of saving, but have been able to demonstrate an increased efficiency without a doubt by the remoal of air by means of a vacuum pump on the return on a two-pipe heating plant. In my experience, if a radiator is narrow or if it is one-pipe, you get a higher efficiency from it than you do when it is several pipes deep. This is also true of radiators having three or four loops instead of one narrow loop. Mr. Donnelly also mentions the use of hot water radiators for steam.

Some years ago the American Radiator Company made a test in their factory of a hot water radiator and a steam radiator, both connected up for steam use on a one-pipe system. It was demonstrated positively that the hot water radiator was not adapted for that purpose when the connection was made at the bottom. Each had steam connection at the base or return connection on the opposite end. The hot water radiator was filled with steam at the top and bottom and the air bound in the center.

SECRETARY MACKAY: I do not understand from Mr. Bishop's description of his method of removing air whether that return pipe had a pressure against it or whether it discharged into the atmosphere. It seems to me that would make a difference. I had a peculiar experience some years ago. I set up a hot water heating apparatus for testing hot water boilers. The radiators we



HOT WATER RADIATOR USED IN STEAM HEATING.

used were base and top and they answered our purpose, and then were left in place for heating the building. Later a steam boiler was installed and we we undertook to test it on these same hot water radiators. We had reports during the day and the report of the night watchman every hour as to the pressure maintained and the radiators were reported to be warm. We found that the entire center of this radiator was not heated. Both sides and top of the radiators were warm but the central portion remained perfectly cool except for what little condensation trickled down. The radiator was fed at *A* (See Sketch). The return *B* being of the same size. We placed air valves at *C* and *D*. The only way I could remedy the trouble was to insert a tee at *E* and extend a pipe from *E* half the height of the radiator, placing an automatic air valve at the upper end *F*. I was then able to extract

85 to 90 per cent. of the air that was in the radiator.

MR. BLACKMORE: It does not seem to me that the problem is entirely solved by the air removal and I do not think that the problem of air removal will be solved properly until experiments are made as to the consumption of fuel by the boiler to determine, not so much the efficiency or condensation of the radiator, but the actual amount of fuel consumed.

There is a certain amount of steam used in the mechanical effort of dispelling air provided there is no vacuum system attached to the radiator. Prof. Kinealy, I understood, made this experiment with different degrees of vacuum from 20 inches down and he found that he got increased efficiency due to the greater condensation of steam. If the experiment had been carried further, with the vacuum system taken off to see what efficiency would be had if the radiators were expelling steam from the ordinary air valve, the experiment would have been checked up a little better and it could have been checked up still further if he had found out the exact amount of steam used from the boiler to see what effort it had taken to expel the air by the steam without the vacuum.

I have had occasion to make some experiments by putting a radiator in a tank and I found very much to my surprise that the vacuum that was produced in this radiator did not increase the condensation but it did increase the temperature of the air. I found, however, that by increasing the pressure in the radiator by throttling down the return pipe, I got a very material increase of power radiated through the water in the tank and the condensation. So that when we put the vacuum on, the steam does not impinge so hard against the surface. Therefore there is not so great a conducting power. How far that applies to the radiator heating the air I have not been able to tell, but I do know that it has been shown by a number of experiments recently that the same water heaters with different pressures, by blowing the pressure through the top and drawing the steam through a tube, resulted in the efficiency for heating water of 25 per cent. and when they throttled the tube on the return pipe and put the pressure flow at the inside of the tube, they could get very much more hot water. Thus the factor of the steam impinging against the side surfaces to transmit the heat by conduction through the inner temperature to the outer is quite a factor. Now it may be possible to have a perfect vacuum in the radiator and yet not have the steam impinge the side of the radiator sufficient to transmit the heat.

MR. MALLORY: I would like to ask Prof. Kinealy if he made his experiments with the supply to the radiator and the return or air vent taken from the bottom or whether his steam supply was from the bottom.

MR. KINEALY: I made no experiment of a cast iron radiator with steam connection at the top.

SECRETARY MACKAY: I have found that the location of the air valve and the size of it has something to do with the efficiency of the radiator and when I had sufficient size and proper location, I could extract sufficient air to make the radiator work all right. Regarding extracting air from coils and the greater difficulty of getting air from coils than from radiators, I find that some make the mistake of taking an air valve that they are willing to put on a small radiator and expecting the same air valve to operate on 100 square feet of surface.

TOPIC NO. 2.

The Proper Air Space Between the Surfaces Exposed in the Heaters of Blower Systems.

DISCUSSION.

MR. KINEALY: If the pipes on the hot blast coil are about 2⅛ inches center to center and the air passes through the coil with the velocity of 1,000 feet per minute, you get a certain heat effect. If the pipes are 3 inches center to center, to get the same heating effect, we have got to have coils that will be twice the number of pipes in depth. One coil, if the pipes are spaced 2⅛ inches, would be 16 pipes deep; if they are 3 inches from center to center, the coils would be about 34 pipes deep. If the coil is 16 pipes deep, we can arrange that coil to have 4 connections, each connection taking a valve and a pipe. If, on the contrary, the coil is 34 pipes deep, then if we have 4 pipes to a connection, we will have 8 connections, 8 pipes and 8 valves. If we put on a header and divide the coil into 4 parts, as when we had the coil 16 pipes deep, then we will have 8 pipes to three headers and 10 pipes to one of the headers. That means larger valves. All of this means that if we get the pipes close together in the coil, the coil will take less space and the cost of connecting it up will be less than if the pipes are far apart. It is almost impossible to make the coil having a return bend and 4 pipes to a base without putting the pipes 2¾ inches from center to center. Otherwise their connection at the top cannot pass between adjacent pipes. The result is that if we use a 4-pipe base, we have got to have the pipes pretty nearly 3 inches from center to center, or we have got to use a base that is known as the Sturtevant base. I like a base that has the pipes 2½ inches from center to center and 2 pipes to a base because I can buy that of any manufacturer, it is easy to obtain circulation with it and it heats fairly well. It takes

more space than a base having a pipe 2⅛ inches from center to center, but not so much space as a base having pipes 3 inches on center. I think that within reasonable limits, the closer we get the pipes toegther, the more effective is the heater but the construction of the base is usually such that we cannot put them much closer than 2⅛ inches from center to center.

SECRETARY MACKAY: I would like to ask Prof. Kinealy if he refers to spacing the pipes side by side across the heater or with the air across the air?

PROF. KINEALY: I meant lengthwise of the base, although the distance from front to rear is usually about the same as the distance lengthwise from center to center.

TOPIC NO. 3.

In Blower Systems of Heating and Ventilation, what are the Maximum Allowable Velocities in the Different Parts of the System, and What Limits the Velocity and Why is it Limited?

DISCUSSION.

MR. MCCANN: In a great many cases in school work, I find that when the velocity is too low, the result is as bad or even worse than if the velocity is too high. The limit is therefore what you might call a happy medium. If you get a velocity too low, the air will return from one flue to the other. We have had that in some cases in schools where the air would go from one classroom down into the main trunk and up the other flue because the velocity in the main trunk was so low that there was not pressure enough apparently to force the air into the classrooms and the outside influences overcame the force of the blow. On the other hand, if you get the pressure or the velocity too high the rattling of the checks or ducts will cause noise that will be objectionable. We find in school practice as a rule that a velocity of 1,500 to 1,800 feet per minute in the main ducts at the blower was not objectionable, but was even advantageous and the velocity decreased, of course, until in the classrooms it would be about 400 or 375 feet a minute. The ducts leading to the classrooms having that flow per minute. Of course what I have said applies to the larger blower. Where we have smaller blowers, we never have the velocity so high in the main duct as there is no necessity for so much pressure.

PROF. KINEALY: At what pressure do you run your blowers when you have a velocity of 1,500 to 1,800 feet per minute?

MR. MCCANN: I do not know. I have never measured the pressure, but we figure on ¾ of an ounce.

MR. LEWIS: I should like to ask Prof. Kinealy what he considers a good approximate speed of the air through the heater to give the best results.

PROF. KINEALY: For ordinary school work and hospital work, a velocity in the neighborhood of 1,000 to 1,100 feet per minute will give good results. For factory work, 1,200 to 1,400 feet, although of course that means running the blower at a speed to give a high pressure. The friction of the air through the heater is considerable and increases very rapidly as you increase the velocity. Ordinarily if you are running the blower at a speed to give a pressure of half an ounce, the friction of the air through the heater will be such that you will have not more than $\frac{3}{10}$ of an ounce to overcome the friction in the pipes. That is when the air passes through the heater at a velocity of about 1,000 feet. If you increase that velocity, then you decrease the available pressure to force the air through the ducts or pipes into the room. You also decrease the pressure you can maintain in the room and thus cut out the air from high wind.

TOPIC NO. 4

Summer Tests of Heating Systems.

DISCUSSION

MR. CHEW: One of our correspondents said I think that with the temperature outdoors at about 70 degrees with an indirect heating system, if you could get a temperature of about 104 degrees in the building, you could calculate that that building could be made comfortable when the outside temperature was zero by the same heating plant.

MR. R. S. THOMPSON: Regarding the statement made by Mr. Chew, it seems to me that there ought to be something additional ascertained. I do not believe you could satisfy the average man that 104 degrees outside temperature and 70 degrees inside temperature corresponds to 70 degrees inside temperature and zero outside.

MR. MAY: It seems to me that this very discussion that has taken place is a good and reasonable ground for taking side with Mr. Walter Jones in his paper, "Heat Losses and Heat Transmissions." It seems to me there is a variation of transmision through radiation which is not in uniform ratio.

PROF. KINEALY: This matter was investigated years ago by this society in a report submitted by a committee, a standard method was established for testing indirect radiation work, but the report required that the tests should be made when the outside temperature was under 45. All our data were indefinite after we got above 45 or 50 degrees.

MR. BLACKMORE: I do not think it is possible to test a house except in cold weather. It can be tested at 45 degrees.

MR. JAMES MACKAY: How would Mr. Blackmore figure that out if a heating apparatus were put in to-day? Would he wait until it was 45 degrees to make the test?

MR. BLACKMORE: We always get a temperature of 45 degrees very early in the season.

AFTERNOON SESSION, JULY 19TH

At this session the preliminary reports of the three special committees were read, the first being that on Standard Sizes of Steam Mains and Returns for Small Buildings, by James A. Donnelly, chairman. The committee's report followed.

Preliminary Report of Committee on Standard Sizes of Steam and Return Mains

Our preliminary report at this time is not intended to be at all complete or thorough as to the data that we have thus far collected, but is more in the nature of general remarks on the subject tending to show that American practice is surprisingly uniform and that it is very probable that in the near future a standard may be prepared which will represent an average differing to such a comparatively slight extent from the figures of each individual contributor that it will receive universal and spontaneous indorsement.

The collection of the data for such a standard as this is clearly within the scope of the old saw that "there is safety in numbers," there is also correctness in an average derived from a large number of answers and we therefore most earnestly appeal to all those who are interested in this subject, whether they are members of our society or not, to give us the benefit of their knowledge.

The committee prepared a set of questions and sent out 500 copies, including one to each member in this country. About 15 answers were received, all but two of which were from our own members.

The first question, as to sizes of radiator connections, served to bring out an almost unanimous expression of opinion as to agreement with the manufacturers' standard. Most of those who went into details stated that they used nothing smaller than 1¼-inch on one pipe work, and several decreased the amounts 20 or 25 per cent.

The compiled results from the answers in regard to maximum amounts of radiation permissible upon low pressure steam mains in plants of moderate size or those not having over 100-feet run of main is given in the following table and in the diagrams.

		High.	Low.	Av.
1	inch	100	40	59
1¼	inch	125	75	94
1½	inch	250	126	171
2	inch	400	286	335
2½	inch	700	500	594
3	inch	1,280	800	994
3½	inch	1,600	1,100	1,407
4	inch	2,560	1,500	1,971
5	inch	3,900	3,500	3,655
6	inch	6,400	5,000	5,700
8	inch	13,500	8,000	11,850
10	inch	23,800	15,000	20,950
12	inch	40,000	30,000	35,777
14	inch	55,600	40,000	53,137
16	inch	81,000	75,000	78,437

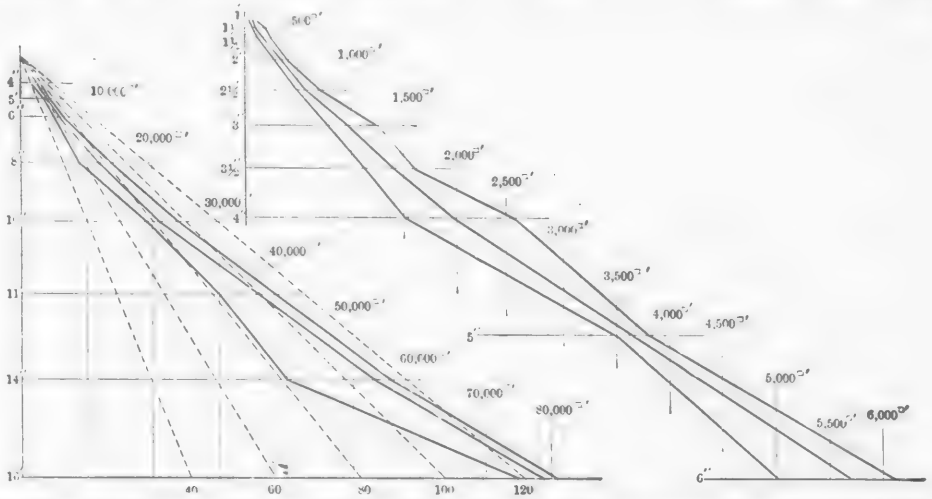


CHART SHOWING MAXIMUM AMOUNTS OF RADIATION USED UPON LOW PRESSURE STEAM MAINS.

In the large sizes the answers run remarkably close together; the average difference in the sizes from 5 to 16-inch between the average and the highest answer received being only 7.4 per cent.; in the sizes from 2½ to 16-inch it is 11 per cent., and in all sizes from 1 to 16-inch, 15.7 per cent.

The greater disagreement in the smaller sizes arises from the fact that some of those answering state that it is their practice to put almost double the amount of radiation on a pipe as a steam main than as a radiator connection; while others put less on it as a main.

Many of the answers received do not

take up the question of return main sizes at all, and those that do differ to a considerable extent.

Almost all agree that the adoption of a standard would be desirable and beneficial to the profession.

DISCUSSION

MR. DONNELLY: I have prepared a diagram (reproduced herewith) which shows the largest sizes and the smallest sizes now in use. By reference to the diagram, it will be noted how close the average size corresponds to the highest size used. One answer was received which was quite low.

Report of Committee on Collection of Steam Heating Data

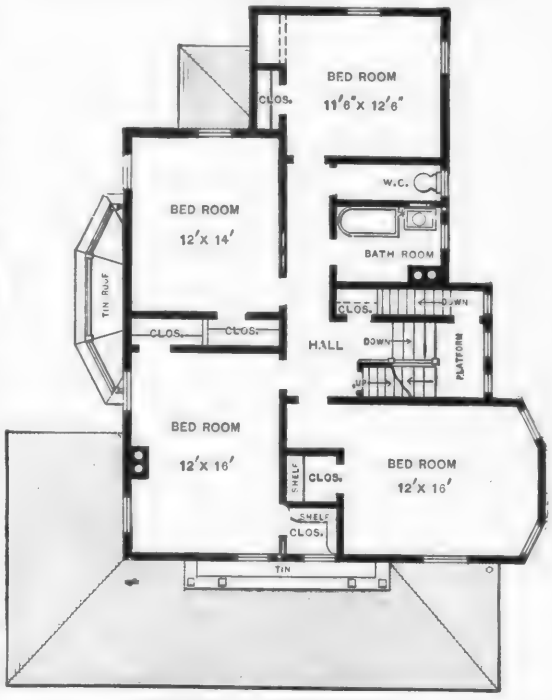
At the last annual meeting of the American Society of Heating and Ventilating Engineers, held at New York in January, the question of collecting data on steam heating of small buildings was discussed.

It was generally felt that the records of the society did not contain, in a concise form, the opinions of enough members to put on our records the general practice in vogue for this class of building.

A committee of three was appointed as follows: J. J. Blackmore, B. H. Carpenter and A. M. Feldman, to collect data for the use of the committee on standards, who will tabulate the data gathered for publication in the transactions of the society.

FIRST FLOOR PLAN

The committee beg that you will carefully read over the enclosed circular, and as far as possible, answer all the questions raised, and any more that occurs to you,



SECOND FLOOR PLAN

that will throw light on the practice in use in your locality for such buildings. A complete specification for such a building from you, stating how you arrived at the different size radiators and the size boiler, would materially assist.

The questions asked are not complete, but are intended to bring out as far as possible all the salient points in connection with such a heating apparatus. For the purpose of figuring, we will assume the first floor has a 10 foot ceiling, the second a 9 foot, and the attic 8 foot.

Trusting you will give this matter your earnest consideration, and give us all the data you have on the subject of steam heating for small buildings, we are,

Very truly yours,

J. J. BLACKMORE,
B. H. CARPENTER,
A. M. FELDMAN,
Committee.

QUESTIONS OF COMMITTEE ON STEAM DATA

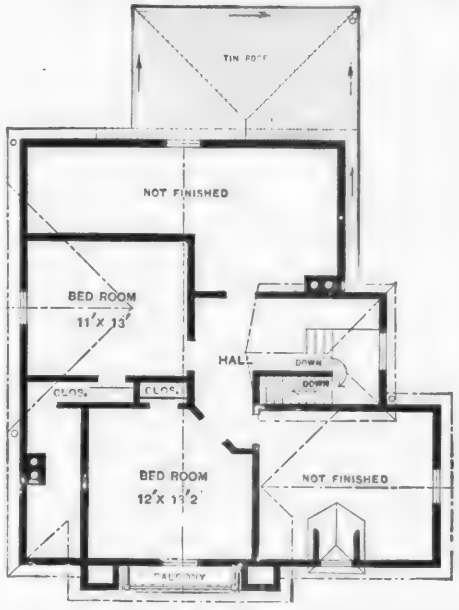
1. What method do you use for determining the amount of direct steam radiation needed for small buildings such as small and medium sized residences and stores?

2. If you use a rule that provides for wall exposure and glass exposure, please state what such rule is and how you came to adopt it.

3. If you figure from the cubical contents only, how do you provide for the different exposures and how have you found the rule work out?

4. In your calculations, do you figure for any definite pressure of steam in the radiators when figuring a given quantity of radiation to heat a house in zero weather?

5. Have you had experience in (so called) direct indirect heating for such buildings? If so, how much extra radiation do you figure? Do you figure on any definite quantity of air being introduced into rooms in such a system?



ATTIC PLAN

6. What is your method of figuring for indirect radiation? Number of changes of air per hour? Method of extracting foul air from the room? Method of boxing indirect?

7. Size of cold air inlet compared with warm air outlet?

8. Size of cold and warm air per foot of indirect radiation?

9. Space for cold air below stack and for warm air above the stacks?

10. What rule do you adopt for sizing up the boiler for a job?

11. For direct radiation?

12. For direct indirect radiation?

13. For indirect radiation?

14. Have you any rule for grate area in small and medium sized steam boilers?

15. Do you compare the grate surface and heating surface of a boiler with its rating before purchasing?

16. What factor of safety do you figure on for the difference in the construction of buildings?

17. Do you have a different standard or rule for brick and frame buildings?

18. Do you consider the construction of a building apart from glass exposure and wall exposure? That is, if it is a wall constructed building or otherwise?

DISCUSSION

MR. BLACKMORE: I might say that our committee has been unable to get down to definite work in the way of compiling data for the reason that it is an exceedingly difficult matter to get at and in order that we might obtain the data, the committee decided to send a letter to each one of the members with a list of questions. This circular letter constitutes our preliminary report.

Preliminary Report of Committee to Secure Data on Hot Water Heating

A preliminary report of this committee was read by the chairman, Mr. James Mackay, and was published in our July issue.

DISCUSSION

MR. JAMES MACKAY: This preliminary report gives a synopsis of what we have done up to the present time. We have divided the subjects up among the members of the committee. For instance, I have taken the part relating to boilers, Mr. S. R. Lewis that pertaining to radiators and Mr. E. F. Capron that part pertaining to piping.

(This report, as well as the two preceding it, will be printed and sent to members for the purpose of securing additional information in time for the annual meeting in January.)

Application for a Charter for a Local Chapter of the Society

Following the reading of the reports, the following communication was presented:

Board of Governors of the American Society of Heating and Ventilating Engineers:

Gentlemen—We the undersigned, Illinois members of the American Society of Heating and Ventilating Engineers, do herewith make application for a local chapter of the society, headquarters of which should be in Chicago. Said chapter to be governed by its local officers in conjunction with the by-laws of the American Society of Heating and Ventilating Engineers and be under supervision of its Board of Governors and such local by-laws as may be found necessary, which must be approved by the Board of Governors of the parent society. All applicants for membership of said chapter shall first be members of the American Society of Heating and Ventilating Engineers.

Yours respectfully,

T. J. WATERS,
AUG. KEHM,
J. M. STANNARD,
JOHN F. HALE,
R. A. WIDDICOMBE,
N. L. PATTERSON,
S. R. LEWIS,
E. F. CAPRON,
JOHN BOYLSTON,
JAMES MACKAY,
GEORGE MEHRING.
JOHN K. ALLEN.
SAM'L G. NEILER,
W. B. GRAVES.

This application, as already stated, could not be granted without an amendment to the by-laws. On motion of Mr. James Mackay, it was voted to submit a mail ballot to the members on the question of an amendment providing for the granting of charters to local chapters of the society.

The Elimination of Redundant Parts in the Forced Circulation of Hot Water. by A. H. Barker, Trowbridge, England

(This paper was published in our July issue. In the absence of Mr. Barker, it was read by Prof. J. H. Kinealy.)

DISCUSSION.

MR. DONNELLY: It would be interesting to have some data in regard to the necessary tray service to heat water for a given amount of radiator surface. As to his piping, if he had mentioned his sizes it would be interesting information to several of the committees. In connection with the apparatus, as shown in Fig. 1, it seems to me the header and ejector must have some intermittent means of working the floats. As here shown, they are continuously operating floats. It seems to me they must have some intermittent means of operating the two valves which would tend to make it more complicated than it is shown. There is no means shown whereby the steam valve is closed before the exhaust valve opens. You first have to close the exhaust valve and then open the steam valve, keeping it open for a certain length of time and emptying into this tank, because the pressure in this ejector must be greater than that of the steam flowing through the heater. Incidentally the tank must be on a higher level than the heater in order to get a gravity float from the expansion tank, that is, from the apparatus to the heater. When the water goes back to the ejector, it must open the exhaust valve and close the steam valve.

TOPIC NO. 5.

Natural Versus Mechanical and Upward Versus Downward Ventilation for Rooms in School and Larger Auditoriums.

DISCUSSION.

MR. WATERS: This is a subject that I have had under consideration for some time. I communicated with Mr. D. M. Nesbit, a member of this society in London, about two months ago. He very kindly forwarded me two copies of reports on the ventilation of the House of Commons. The whole subject, as presented in these reports resolves itself into a question of whether or not we are to take a step backwards 20 or 25 years or continue in the progress which we have made during that time. I hope to be able to present something in a tangible form at the next meeting.

TOPIC NO. 6.

The Advantages Attending the Use of Steam and Hot Water in Heating a Number of Buildings Requiring 150 to 200 H. P. from a Central Plant.

(Owing to the absence of the member presenting this topic, there was no discussion.)

TOPIC NO. 7

The Best Method of Calculating the Sizes of the Mains in a Hot Water Heating Plant.

DISCUSSION.

SCERETARY MACKAY: That topic can possibly be taken up by our committee on hot water heating. It is along their line.

TOPIC NO. 8.

The Effect of the Size of the Main on the Height of the Water Line in Different Parts of a Gravity Steam Heating System.

DISCUSSION.

MR. J. J. MCNICHOLL: I installed a steam heating plant in Oshkosh two years ago with a brace of two boilers in it, heating a school house, a large church and convent from a central plant. The plant in the church was originally hot water. That proved a failure, and when they built a new school house, we used the same piping that was made of coils and headers placed against the walls of the church. I turned that into a two-pipe steam job. I left the mains in the basement of the church the same as they were, 5-inch flow and returns. Those pipes in the church figured up about 3,000 feet of radiation. I carried a 6-inch main over to the church and I have but an 8-inch water line. I heat the church and school house and the Sister's house with not over 3 pounds of steam. Most of the time 2½, and the water makes no attempt to leave the boiler. If you will tell me why that is, I should like to know. The pipes are 6-inch, taken from the top of the boiler. They run to the wall of the building, dropping down and going through the walls, thence under ground over to the church, where there is an 8-inch water line. This was because the owner would not have the piping carried across lots between the buildings and the church. It was a gravity apparatus. The return pipe is on the same level with the flow pipe and is above the water line of the boiler. The only drip I have is from the flow pipe into the return to take care of the condensation.

SECRETARY MACKAY: Of course it is altogether a question of his flow main and return, or, in other words, making the system a part of the boiler.

MR. MORGAN: I have been called on once or twice to stop a boiler throwing its water and the only remedy I offered to adopt was that of increasing the size of the return pipe from the point where

it had been reduced to full size, thus doing away with the friction in the smaller pipe.

TOPIC NO. 9.

The Relative Economy in Fuel of Steam, Vapor, Vacuum and Hot Water Heating for Residences.

DISCUSSION.

MR. BISHOP: Will anybody disagree with me in this statement, that it requires the same number of B. T. U. per hour to heat a room or a house regardless of whether those thermal units are supplied by the sun through a magnifying glass or from a hot air furnace, stove, oil lamps, steam, hot water, vapor or anything else? In other words, it takes so many B. T. U. to heat a given room to a certain temperature and does not the whole thing come back to the generating apparatus?

PROF. KINEALY: I think the answer to Mr. Bishop's question is yes and no. It is true, I think, that you can put one apparatus in a room and that apparatus will require more heat units to generate and maintain a given temperature in the room than another apparatus. It depends upon the efficiency of the utilization. If we put into a room a certain number of heat units under one condition and ask if it will maintain the same temperature in the room as when placed in the room under another condition, I do not think they will.

(Prof. Kinealy illustrated his point by drawing a room on the blackboard and indicating the location of two charcoal braziers, one on the floor and one against the ceiling, showing that the brazier placed near the ceiling would be less efficient owing to the loss of heat through the ceiling).

MR. BISHOP: I might have added further to the question, assuming that the point of inflow of the heat currents were all from the same point.

PROF. KINEALY: Very well. I draw here a radiator close to one of these walls and I heat that radiator to a temperature of say 300 degrees. Now the wall close to this radiator is heated to a very high temperature, there is a very large conduction of heat through that wall. Your apparatus will require more heat than if you put a larger radiator in the same place, maintaining in it a temperature of, say, 100 degrees.

MR. HOFFMAN: I should like to ask if it is not also dependent somewhat upon the amount of surface you have, as you are depending upon the circulation of the air to heat the room? The greater amount of radiating surface you have in length and height and breadth, the more air you will circulate.

SECRETARY MACKAY: It seems to be a question in the mind of the gentleman who suggested this topic whether there is sufficient advantage and economy in vapor or vacuum systems to counteract any additional cost or warrant their installation in place of the gravity system, low pressure, hot water apparatus, heating a building to 70 degrees during the winter weather.

MR. BRENNAN: I have talked with a great many engineers who have used vacuum systems with low pressure and they installed an electric ejector pump to pump back the condensation. By increasing the pressure, to 60 or 70 pounds, they show a saving. I would like to have an opinion regarding forcing the boiler by increasing the pressure to 60 or 70 pounds and then reducing it to 2 or 3 pounds in the radiators and then pumping the condensation back to the boiler.

MR. BISHOP: Mr. Brennan's question is whether it is greater economy to raise the boiler pressure, as I understand it, than by having the steam remain at a certain pressure. That is a matter we have gone into quite extensively in the way of making experiments on a large scale and we have found it to be very economical.

I would like to know why a pound of steam from an engine should heat a greater amount of space, reduced from high pressure than live steam? One of the members of this society gave this reason for it. He stated that the boilers, delivering steam at a comparatively constant velocity had the same effect upon the water in the boiler as a siphon has in a water reservoir, whereas an engine placed between the boiler and the heating plant, connected with supply, exhaust and intake valves, which are being constantly opened and closed, consequently create a certain amount of entrained water in the boiler, while there was a constant demand. It seems to me the only plausible reply I have ever heard.

PROF. KINEALY: I do not think it will take any more steam to heat, but I do know that in the same proportion, less steam will be used for power and heating with a given drop of pressure than would be used for a given drop of pressure where you heat alone. That is, suppose you had a plant where they are using steam at 10 pounds pressure for heating. Now, if you drop this back pressure on the engine to zero pounds, or half a pound, the economy in the plant will be greater than if you use live steam for heating at 10 pounds and drop the pressure to half a pound. The saving will be greater where the steam is used partly for power and partly for heating. That is due to the fact that you mak a saving in the amount of steam you use for power.

MR. DONNELLY: The engineers in several office buildings tell me that with the same outside temperature it costs less on Monday to produce the power used in the building than it does on Sunday to heat the building alone. It seems to be

an established fact that you can produce power in a building, in some cases with heat with less coal than you used to heat it alone.

MR. HARVEY: A heating apparatus acts as a partial condenser and I think you get a partial condenser on the heating apparatus. I think that is what we have on our plant, for we can heat our whole factory with steam cheaper on Monday than we can on Sunday. But I consider it due to the fact that we pump back all the water of condensation and have a partial vacuum on the heating plant, whereas the steam on Sunday would just escape through a drip.

MORNING SESSION, JULY 20TH.

Notes on the Use of Feed Water Heaters in Connection with Heating Systems, By William G. Snow.

(This paper was published in our July issue).

DISCUSSION.

MR. DONNELLY: I would like to ask Mr. Snow, in giving the relative surface for his job of heaters, what is the amount of tray surface per horse power for this job.

MR. SNOW: I should say roughly about one-tenth as much as on a closed type of heater. That is merely the tray surface. Of course we have a large area of water that is in contact with exhaust steam as well, which is not commonly computed as heating surface in that class of heater.

MR. STANNARD: In my experience I find fouling of the trays cuts a considerable figure in keeping the water at a high temperature.

MR. SNOW: There are a great many heaters of the open type made without those perforations.

PROF. KINEALY: I want to say something about the connections. In Figure 3, you will notice that the exhaust pipe leading to the heater is an ordinary elbow drip taken from the bottom of the elbow. In Figure 2, there is a T drip, taken from the run of the tee. It seems to me the connection shown on Figure 2 is better.

I have had two instances where water was retained in the exhaust pipe, breaking the engine. All we did was to change the elbow to a tee and drip from the bottom of the tee.

MR. STANNARD: I should imagine that the filling of the pipe and the breaking of the engine, mentioned by Prof. Kinealy, was due to the overflow of the heater and not simply to the condensation from the engine itself. The main thing is to get a heater that will not overflow into the exhaust pipe.

Fads and Fallacies in Hot Air Heating, By R. S. Thompson.

(This paper was published in our July issue).

DISCUSSION.

MR. A. O. JONES: I should like to ask Mr. Thompson if carrying the warm air perpendicularly before turning horizontally would not have a tendency to obstruct the flow, or the velocity of the air as in the case of a square elbow? Would not the air flow more readily if it were given a pitch from the outlet at the furnace to the entrance of the register or the bottom of the perpendicular wall pipe.

MR. THOMPSON: I concede that if by pitch you could materially reduce angles, it is an advantage, but the advantage is in the reduction of the angle and not in the pitch.

PROF. KINEALY: I should like to ask Mr. Thompson how he derives the rule given for determining the number of cubic feet that would be required per minute to maintain a temperature of 70 degrees with the outside temperature at zero.

MR. THOMPSON: I worked that out somewhat on this plan. Various tables have given me a rule which I find in practice usually works out right, of allowing 38 B. T. U. per hour for each square foot of wall surface. After figuring 38, multiply it by the square feet of exposed wall surface and divide it by 2 and then reduce that to the number of cubic feet of air with 70 and 55/100 heat units per cubic foot. I take the extreme length of the building. I pay no attention to the angles. The extreme length and extreme width, add these together and multiply them by the height.

PROF. KINEALY: Mr. Thompson says "a house heated by hot air needs no ventilation but what the furnace gives it." That, of course, is supposing that the furnace takes all the air from the outside. Would that statement apply if the furnace took the air from a cold hall?

MR. THOMPSON: Not if the furnace took all the air from the inside. I would say that my calculations are based on the furnace taking the air from the outside.

That brings up a little fad of mine. I note that some scientific investigations show that it is not the carbon dioxide that makes the air bad. It is the organic mater that is bad. I believe the organic matter in the air is what makes the air poisonous and that the carbon dioxide you can probably neglect. I believe the organic matter is gradually oxidized. Now, if you heat your house with hot air and provide for a rapid and vigorous circulation, are you not, to a certain extent, going to accomplish that same thing, the oxidation of the organic matter and partial purification of the air, so that there may not be the necessity if you get a high velocity for 25 cubic feet of fresh air per minute for each inhabitant, but I do not lay that down as a rule.

PROF. KINEALY: Then it is not the impure gas in the air but the organic matter that is unhealthful?

MR. THOMPSON: That I believe is pretty well shown.

PROF. KINEALY: So that one may take no air from the outside at all and yet by recirculating the air in the house maintain a higher degree of purity in the air in the house than if he took the air from the outside altogether, because the air taken from the outside will contain dust and other organic matter?

MR. THOMPSON: I do not want to lay that down as my doctrine, but that is the doctrine I am edging towards.

PROF. KINEALY: That explains, then, why it is that the physician sends his patient to Colorado or Arizona rather than keep him in a house supplied with air from the outside, and if the physician would prescribe that the patient installed in his house an apparatus for freeing the air of organic matter or washing it or cleansing it, it might be that the patient would be better off than if he were sent to Colorado or Arizona.

MR. THOMPSON: I believe he would.

PROF. KINEALY: I think so myself. In other words we ought to install such air purifying apparatus. (Applause).

MR. JONES: The question has been asked as how to determine the amount of air necessary for a given room. I should be pleased to quote a rule that I have followed with success. It is as follows: "The exposed wall surface less doors and windows, divided by the thickness of the wall, in no case less than 10, added to the actual glass surface considering doors as glass surface, the total multiplied by 75, and added to the cubic contents and the whole multiplied by .013 gives the area in square inches of the warm air conductor." I would recommend a conductor to the second floor rooms to be half the size of the conductor to the first floor rooms.

MR. JAMES MACKAY: Do I understand this rule means the same for risers to the first and second floor, or do you make a distinction in the risers?

MR. JONES: No sir; this rule means for horizontal conductors with an elevation of 1 inch in 12. In perpendicular conductors, the velocity of the air is increased so that their area can be reduced.

MR. JAMES MACKAY: Would that rule apply to both the first and second floors alike, from the furnace to the risers?

MR. JONES: The same rule holds good from the furnace to the bottom of your riser taking into consideration the increased velocity in your perpendicular pipe.

TOPIC NO. 10

The Relation of Heat Units per Cubic Foot and the Cost of Gas to Its Economical and Possible Use in Heating Water.

DISCUSSION.

MR. THOMPSON: I made some experiments in the use of gas and the cost of heating hot water for domestic purposes. Incidentally, I convinced myself that the radiation from a given surface increases very rapidly per square foot per degree difference per hour as the temperature difference increases. I was very much interested in the problem as to whether artificial gas, at $1.00 a thousand cubic feet could be practically used in supplying domestic hot water. The point I worked out was that the use of artificial gas for domestic hot water heating would be entirely practical under any reasonable circumstances if the loss by radiation were removed. Loss by radiation from the average hot water boiler is very great, especially if it is in the cellar. By removing the loss by radiation, you would make practical the use of gas by hot water heating.

TOPIC NO. 11

In a Hot Air Furnace, Burning Five Pounds of Anthracite Coal per Square Foot of Grate per Hour, What Proportion of Heating Surface Should be Provided in Relation to the Grate Surface to Insure Economy and Efficiency?

DISCUSSION

MR. JONES: Inasmuch as 5 pounds of coal per square foot per hour is a maximum allowance, I should say that the heating surface should be the maximum, which is 20 square feet per square foot of grate surface.

TOPIC NO. 12

When the Cubic Contents and Temperature of the Air Supply are Known, What Velocity should be Considered When determining the Size of the Horizontal and Vertical Pipes and Register Outlet in a Warm Air Heating System With Outside Air Supply and When the Air is Circulated, also the Size of these Air Supply Ducts and the Velocity in Them?

DISCUSSION

MR. CHEW: This topic and the one immediately preceding it were sent in by Prof. Kent, chairman of the committee on collecting furnace data. This topic makes the basis for papers, from which the committee on standards could tabulate their information and answer many of the questions that are raised here at different times.

MR. THOMPSON: This question is almost impossible of practical answer because the conditions vary so. I never had any trouble, where I had a perfectly straight pipe and a run of not over 15 feet, of getting a velocity in 10 or 12-inch pipes of from 200 to 250 feet per minute for the first floor registers. It all depends upon the size of the pipes, the number of angles, the amount of friction and such conditions.

AFTERNOON SESSION, JULY 20TH.

Wall Radiators Versus Long Pipe Coils, By J. A. Donnelly.

(This paper was published in our July issue).

DISCUSSION

MR. KERR: I would like to ask Mr. Donnelly whether if he could install wall radiators at the same cost that he could build pipe coils, he would use radiators or the coils.

MR. DONNELLY: If it was left entirely to my judgment, I would rather use wall radiators on account of the radiating surface, in that case, being under the windows and I believe that the cost of maintenance would probably be less. Then, under ordinary conditions, I think the air removal is more easily accomplished with wall radiators than with pipe coils. The difficulties in taking care of the expansion in either case are about the same.

MR. WOLFE: I would like to ask if Mr. Donnelly has ever made an actual test of the condensation of water per square foot in each.

MR. DONNELLY: No, I have rated them in accordance with my experience. I have rated coils at 300 B. T. U. per square foot per hour and wall radiators at 290. It is a question of air removal.

MR. HARVEY: In heating an ordinary factory, would you not consider a 1¼-inch coil 25 feet long, not exceeding that, to be more economical than cast iron sectional radiators, owing to the better distribution of the heat?

MR. DONNELLY: I think the method I have shown gives better distribution of heat than coils 25 feet long because just the surface needed for heating is laid out under the windows.

MR. HARVEY: But the coils would be under the windows, too.

MR. DONNELLY: They would also be along the blank wall space between the windows if they are 25 feet long.

MR. HARVEY: But in heating this wall space, the wall would absorb a certain amount of heat and give it out afterwards, would it not?

MR. DONNELLY: Yes; I do not think the amount of steam used would be a factor in either case. The heating of a room with radiation under the windows is a little more pleasant to the occupant of the room that are at work near the windows .

An Improved Application of Hot Air Heating, By A. O. Jones.

(This paper was published in our July issue.)

DISCUSSION

MR. DONNELLY: I would like to ask whether Mr. Jones uses any dampers in the hot air pipes leading from the top of the furnace casing to these wall pipes and registers.

MR. JONES: Yes, I would recommend the use of a damper in each warm air pipe being used with the furnace, if for no other purpose than to be able to close off the heat from both downstairs and upstairs rooms, if it were found necessary to do so.

SECRETARY MACKAY: Did you sy these dampers are for regulating the amount of air? I notice that in the illustration you can drop the damper and can open the registers on both floors, thereby regulating the openings there so that you can balance one room against the other. Do you find that you can control the distribution of air by regulating the dampers on top of the furnace?

MR. JONES: The damper in the basement pipe is really not necessary, excepting as I stated a moment ago, where two rooms are not used or once in a great while one is used. Ordinarily the supply is controlled entirely with an adjustable deflector in the register.

TOPIC NO. 13

The Desirability of Accumulating Data as to the Life of Wrought Iron and Steel Pipes in Steam and Hot Water Heating Systems

DISCUSSION

MR. CHEW: I will explain that Mr. Thomson, of the International Correspondence School, of Scranton, Pa., is making an effort to collect data, as to the life of iron and steel pipes when placed in the ground or elsewhere.

PRESIDENT GORMLY: Along the lines that this topic seems to suggest, we had an illustration a short time ago in Philadelphia in a 9-room dwelling which had a low pressure one-pipe heating apparatus. A steel tube was used to carry the steam and also to carry the condensation back to the boiler. The plant was in use just eight years when it commenced to leak and in taking it out we found that the bottom line of pipe, that is, the inside of the pipe on the bottom line, was corroded entirely through, so that when the pipe was held up to the light, there was a groove in it with holes as large as those in the lid of a pepper box. That pipe was in a dry place, under the second floor so that there was no influence brought on it from dampness outside or by concrete or lime or anything of that kind. That was a case of distilled water taking up the steel and carrying it away, apparently.

I know of another instance where a 5-inch steam pipe lasted only five months. It was a steel pipe and corroded through during that time.

MR. KERR: We have 8-inch wrought iron pipes that have been in use 20 years which show no wear at all. We have other wrought iron pipes that have been in 4 or 5 months and we find on examination that a part of the bottom, ⅜-inch wide is eaten away entirely. Now, we find the same thing on cast iron pipes, these being eaten from the outside as well as from the inside. Of course that is due, partly, to chemical action, yet in some places, we have

taken out large wrought-iron pipe from a trench in which it had laid with the covering off and it was wet inside and out, yet it showed no wear on the inside, while the outside was all pitted. I would like to know why certain pipes give away at the fittings? We have had cases where electricity has done it, but not in the pipe I have in mind.

MR. MAY: There are several central heating plants nearby Chicago which have been installed about five years. We have commercial steel pipes in the houses and those pipes are all pitting, so that they are gradually being replaced. I understand that in that particular locality the water is highly impregnated with magnesia.

MR. MORGAN: I have seen the same thing happen in tne bottom pipes of manifold coils. They were all pitted on the bottom.

TOPIC NO. 14

Chimneys versus Forced Draft and Their Relative Advantages.

DISCUSSION

Chimneys vs. Forced Draft and Their Relative Advantages

At our last annual meeting in New York I read a paper on forced draft so that the members of our society know my opinion as between tall and expensive chimneys and forced draft for economy and capacity of boiler plants.

Since then I have had more experience and am stronger in favor of forced draft now than I was then, as it gives better results in saving in cost or fuel and does give larger additional power to the boiler and at the same time is better for the boilers when properly handled. Among the plants of the tall chimneys that we have arranged to change is the modern plant of the 23-story St. Regis Hotel of New York city.

However, at the present time the question of smoke ordinances and getting rid of the smoke or unburnt carbon from boilers, furnaces, locomotives, etc., is one of the most important objects for us as engineers to take up and discuss not only for our own benefit as a society of practical, consulting and contracting engineers, but for the benefit of our clients and customers and, more especially, for the people in general.

There is no doubt that in a large part of this country and also in Canada and most parts of Europe, the smoke issuing from the fires of boilers, locomotives, etc., is a serious injury to the health and comfort of the people. Can it be stopped; or at least improved enough to do away with most of the smoke, without too great a cost to the owners of boilers, furnaces, etc., and at the same time without increasing the cost of the fuel? If smoke can be done away with or even improved by the influence of this association, it will be doing humanity a great service and one that will be fully appreciated by many millions of people.

Just think of how many thousands of white dresses worn by the ladies are spoiled each and every day by these nasty black spots, while this fashion is in vogue. The feminine part of humanity will certainly bless us and I presume pray for our ultimate success When I am in the streets of this grand city (my former home and where I got my education and first business experience of any kind) and in the morning see hundreds of spotless white dresses and then in the afternoon see as many or even more spotted white dresses, I feel as if we should "get to work" on this vital subject. In fact, I feel as if I would be willing to subscribe $100.00 towards a good substantial sum to be raised by our society and others interested for the purpose of making a series of careful, scientific tests to obtain the best, simplest and least expensive system to accomplish the desired result. From such tests as I have made and seen others make, I am in favor of a system of forced draft, when a small amount of dry steam is used in connection with the fan, forcing air into the ash pit and then having an auxiliary pipe of the proper size arranged so as to allow a portion of the air and a small per cent. of steam to go into the fire chamber. This pipe or duct to be placed above the fire doors and to have a series of small holes arranged so as to throw jests of air over the fire and in line with the flame or gases as they pass back to and over the bridge wall.

The pressure caused by the fan under the grate would send this air through the openings in this pipe or duct in a steady, positive, equal stream and, so far as I know or have seen, it will give as perfect combustion as is known to-day. I have also tried the same plan by putting the cross pipe with openings for the jets a few inches back of the bridge wall, throwing the jets on a slight angle backwards so as to have the air and steam from the jets fall in with the gases as they come over the bridge wall. I put this system on two boilers in New York city in a large wood working plant that makes doors, windows, etc., out of pine and other soft wood and had enough sawdust blocks, shavings, to run the two 100 H. P. boilers. It was the worst job I ever undertook in this line but we got the smoke down so that the Health Board passed it, and dismissed the criminal charges against the company.

I should very much like to have you gentlemen who have had experience in this line give us such information as you can.

TOPIC NO. 15

The Durability of Different Kinds of Nipples for Connecting Radiating Systems Relative to the Material and the Capacity to Withstand Schocks and Strains, also the Effects on Boiler Connections.

DISCUSSION

MR. DONNELLY: I would like to know whether it is considered in the trade that the nipple connection between radiators is the weakest point of the radiator.

MR. JAMES MACKAY: The radiator nipples that have been used by the manufacturers have been of cast iron, malleable iron, drawn tubing or stamped nipples. The stamped sheet metal nipple, stamped right out of a flat plate has not been found to be the very best, but it has compensated for this in expansion and contraction. I am referring more especially to push nipples.

We make a nipple of seamless drawn tubing that is made out of boiler tubing and the offset slightly tapered and put into the hubs. That draws together very well and seems to have all the elements of durability. It is more rigid than a stamped nipple on account of its thickness an has as much elasticity. We have also found some nipples made by manufacturers of malleable iron which seemed to be very good. One manufacturer told me that he made them out of brass tubing, offset at a slight taper and drawn tagether; they would seem to be practically indestructible. No galvanic action takes place and the brass compensates for expansion and contraction. Some nipples are made of pretty heavy cast iron. I do not think they will stand a severe shock, although they do stand the ordinary shocks that are met with in moving and disconnecting. They are made heavier and stronger with thick, deep threads and they are put together with Newell gaskets, drawing the two faces up against the gasket, and the nipple is used more as a staybolt than anything else, perhaps.

The trouble with nipples, as I find them, is that you may devise a nipple and coat it with any kind of non-corrosive material and seemingly it will answer the purpose; it takes a number of years to determine whether it will be durable or not. A geat many nipples after being used five or six years are found to be rusted out, resulting in the use of a thicker one. My idea is that a malleable iron push nipple is as good a nipple as can be devised.

MR. KERR: In central station heating, we have been driven to use nearly everything that has been placed on the market. Now the difficulty with malleable iron slip nipples has been that when building up the radiation, they would test out all right, but after six months the radators would commence to leak. The leaking usually came on at the beginning of mild weather in the spring, when the radiator was turned on or turned off at various periods. When we commenced to use our slip nipple radiation some nine or ten years ago, the nipple was turned out of heavy wrought iron pipe. Those nipples, if I remember, were used along the lines some five or six years, until a pressed nipple was brought out, pressed from spun pipe. We found that these pressed nipples would last all the way from two weeks to a couple of years, when they had to be replaced. It became such a great nuisance that we have now entirely abandoned slip nipple radiation in central station work.

PRESIDENT GORMLY: I would like to ask Mr. Kerr whether he is using a threaded nipple now, or how he is connecting his radiators and whether he found more leaks in the water radiators than he did in the steam radiators?

MR. KERR: I have been speaking of producing radiation with water from a central station plant under a maximum pressure of 30 pounds at the radiator. We have found that the screwed nipple radiator is the only one that we have been able to put in without getting into trouble. We have had those on the line now ten years without any apparent depreciation of that radiator.

PRESIDENT GORMLY: Is it not likely that the leak was caused in the water radiator by the top line of nipples becoming heated when the bottom line of nipples were cold, so that the top of the radiator expanded when the bottom was not so hot?

MR. KERR: Without a doubt that caused a great deal of the trouble with the malleable iron nipples; not, however, with the other.

PRESIDENT GORMLY: Did the bottom nipple leak more than the top nipple?

MR. KERR: In the malleable iron nipple, the bottom nipple gave us more trouble than the upper. In the pressed steel nipple there was practically no difference. Wherever there happened to be an impurity in the steel, it practically opened up at that point.

MR. MCCANN: In the New York schools several years ago, the standard was push nipples for all radiators and we had a great deal of trouble with the push nipples wearing out. About the same time, we used what, I think, was a screw nipple with a rubber gasket, for both water and steam. These also gave a great deal of trouble. Since the application of cast iron screw nipples, right and left, made up so tight that the nipples themselves make tight joints without depending on paper or any other packing, we have had no trouble with the radiation on that score.

SPECIAL TOPIC

How Would you Measure the Surface of a Radiator with a Great Many Ornamental Features, and be Absolutely Sure that You

Had the Actual Number of Square Feet of Surface?

DISCUSSION

MR. MCCANN: In suggesting this topic, I might add that the reason I ask is that various radiator manufacturers come to me and say that their competitors are not furnishing full rating and I should like to be able to say yes or no.

PROF. KINEALY: It seems to me that the only way we can do that is to pass a string around each section and get the circumference in that way and then find the length of the section and multiply that by the circumference of the loop. There are objections to that in connection with the ornaments on the surface.

MR. MCCANN: In public work, it is very often necessary to state the exact number of square feet you have figured on and in one case the radiator maker brought a sample and had to have it approved by the Board of Education. It was carefully measured by the chief draughtsman who cut it up into sections and got figures on each line. It was found to be a little bit short of the 5 or 5½ square feet at which it was rated. The manufacturer simply added a pair of ears on the top and thus got it up to 5½ square feet.

MR. MORGAN: The manner in which the surfaces of the radiator are put together cuts a very large figure in the effectiveness of the radiator, in my opinion.

SECRETARY MACKAY: I agree with Mr. Morgan that more important than having the exact amount of surface that is claimed for in the radiator is the condensing power of the radiator, that sufficient air space be left between sections so that air can be got to all of the surfaces.

The discussion of this topic brought the meeting to a close and the society thereupon adjourned *sine die*.

Dinner to the American Society of Heating and Ventilating Engineers

From a social point of view, quite the crowning feature of the Heating Engineers' meeting in Chicago was the complimentary dinner at the Auditorium Hotel, tendered the visiting members and guests by the Chicago members, Friday evening, July 20. The invitation included the ladies, and their presence established a custom which it was hoped by all would be continued on future occasions. The committee having the dinner and other entertainments in charge was made up of T. J. Waters, chairman; August Kehm, secretary; James Mackay, treasurer; Ed. F. Capron, who had charge of the automobile trip preceding the banquet; and John F. Hale, who saw to the many necessary details in connection with the dinner arrangements. That both the automobile trip and the dinner itself passed off so successfully was due in large part to the efforts of these gentlemen, although the entire Chicago membership joined in the warm hospitality that was displayed throughout the meeting.

The dinner was served in one of the banquet halls of the hotel, where tables were arranged to form the letters "H V," the "V" being made by extending a table across the bar of the "H." The head of the table was at the point of the "V," and here were seated President Gormly and Toastmaster James Mackay. Following was the menu:

Little Neck Clams
Cream of Tomatoes, Quenelles
Relishes
Lake Trout, Mornay Gratin
Potatoes Hollandaise
Tenderloin of Beef, Perigordine
Peas à l'Anglaise
Strawberry Sherbet
Roast Sqaub au Cresson
Salad
Meringue Glace Ice Cream
Cakes Cheese
Coffee

After the guests had taken their seats a flashlight photograph was taken of the assemblage, and at each point where a flash was located its lighting was followed by the unfurling of an American flag.

During the course of the dinner music was rendered by an orchestra, and after cigars were lighted professional vaudevillists entertained the company until Toastmaster Mackay arose and announced the toasts of the evening. The first toast was responded to by President Gormly, who spoke on "Governing the Unruly Members." Mr. Gormly said:

Mr. Toastmaster, Ladies and Gentlemen: The American Society of Heating Engineers has always been so well behaved during my knowledge of its character, which extends back to the application for its charter, that it is always a source of pleasure to preside at its meetings. So I have had no experience in handling an unruly body, and will therefore be wholly unable to give you, Mr. Toastmaster, advice on the subject of controlling unruly bodies. The good behavior accords well with the spirit of brotherly love which animates all who come from my native city, Philadelphia. I cannot avoid contrasting Chicago and the great state of Illinois, as they exist to-day, with their condition when in the end of the seventeenth century.

Marquette, La Salle and Joliette, the pioneers of civilization, visited this spot. Could their prophetic souls, which were specially trained to look far into the future, have predicted in their moments of the most profound spirituality anything to compare with this scene of beauty as depicted to-night to those who are fa-

vored by being present? Could the most imaginative soul conceive that the spot which in 1800 was a part of the Indian territory could by any magic be transformed into the grandeur and magnificence of the scenes depicted here to-day? This scene of beauty—the grandest monument mortal men could erect—is a grand testimonial to the energy of the early settler and the present inhabitant of Chicago. Chicago and the great state of Illinois may well be proud of their achievements, and our brothers of the American Society of Heating and Ventilating Engineers are to be congratulated upon this advancement, as their work which is shown to us is the equal of anything this vast country produces. They are specially happy as hosts and entertainers. On this occasion they have specially distinguished themselves. We are fortunate in being with them to-night, when as entertainers and hosts they are in their happiest vein. Brothers of the American Society of Heating and Ventilating Engineers, I congratulate you all on your success as hosts and entertainers. I desire to specially thank you, in the name of our society and for myself, for your kindness and for the very many courtesies extended during the days of our meeting. In particular, I wish to extend thanks to the ladies who have favored us with their presence to-night, adding beauty, intellectuality and charm to this occasion such as could be given in no other way. Mr. Toastmaster, I congratulate you, and through you I thank our Chicago friends who have extended the right hand of fellowship on this occasion—you have given us a trip to fairyland with your fascinating music, your profuse display of flowers, and the grace, charm and elegance of your wives, daughters and sweethearts. (Applause.)

The next speaker to be called upon was T. J. Waters, who said that he was glad that Chicago at this time has had the opportunity of entertaining the American Society of Heating and Ventilating Engineers, and hoped that the presence of the ladies would become a permanent feature of the meetings of the Heating Engineers.

Secretary William M. Mackay was then asked to respond to the toast "US," "for, you know," said the toastmaster, "we in the society think we are about it—just what the doctor ordered. Mr. Mackay will tell us about us."

Mr. Mackay said:

While the subject allotted to me is spelled with only two letters, "US," it is a large, broad and deep one, comprising all that is grand, noble and good in this great and glorious country of ours, whose influence has been and is felt throughout the entire civilized world, and were I able to do full justice to the subject, nothing would be left for the speakers who come after me to talk about.

When Scotchmen assemble and drink their favorite beverage, water ("mountain dew" they call it), in proposing an appropriate toast, they say, "Here's to us; wha's like us?" and the answer echoes down the line, "Na budy." In their prayers they are credited with saying, "Lord, give us a gude conceit o' oursells," and our past history as a society will warrant us in imitating the characteristics of a people of whom it is said: "They keep the Sabbath, the Ten Commandments, and everything else they can get their hands on."

The heating and ventilating engineer is a noble animal. He belongs to that species that walks uprightly, and, while in his wild state he is dangerous and will resent any unkindness, when caught young he can be tamed, exhibits an intelligence that is almost human, and becomes greatly attached to those who are kind to him and love him, and, like other useful animals, he cannot be dispensed with. Nothing has been devised during the past two thousand years that will adequately take his place—and you, ladies, are fortunate in having one in each of your homes.

We, as a society, are justly proud of our existence, our birth, our growth and our accomplishments. Commencing twelve years ago with seventy members who have stood loyally together against difficulties and criticisms which would have discouraged many, we have gone on from year to year, increasing in scope, influence and numbers, until to-day we number close to three hundred members, including not only the leading men in the heating and ventilating field in this country but also in Europe.

From the very beginning our constant aim and endeavor has been to improve existing conditions, to make life better worth living not only for ourselves but for all mankind. We have influenced legislation in favor of healthful laws that would benefit all, but more particularly those who are dearer to us than life itself—the children and youth of our country.

After persistent efforts we have succeeded in accomplishing much along these lines, having such laws enacted and enforced in three states—New York, New Jersey and Pennsylvania—and being largely instrumental in enforcing a similar law in Massachusetts; and while the good influence of these laws has pervaded the educational forces of the entire country and has awakened interest along these lines in Canada, England and many European countries, we are continuing our efforts, with a possibility of greater success, and will not desist until every state shall have adopted similar beneficial laws.

Our standing and special committees have done and are doing good work, and while all of our members have ably as-

sisted in accomplishing this work, we have no better or more loyal members than those in this great state of Illinois, and we, as a society, have endeavored to show our appreciation by meeting with you at our summer meetings more often than in any other section of the country, this being our third meeting in your beautiful city—each time adding renewed interest and making it more easy to accept your continued invitation and kindly hospitality, and you can have anything we have.

Our meetings have awakened interest and stimulated thought along new lines, resulting in improved appliances, which, while, as was said to-day, we are yet in our infancy in development along many lines, these new appliances and systems assist alike the owner, the occupant, the fitter and the heating engineer, and will in time make our returns larger.

"Men, my brothers, men the workers,
Ever seeking something new,
That which they have done but earnest
Of the things which they shall do.

"Let us then be up and doing,
With a heart for any fate,
Still achieving, still pursuing,
Learn to labor and to wait."

Responding to the toast, "Our Associate Members," John K. Allen spoke of the advantages to be gained by increasing the associate membership among men who, while not heating engineers, could do much in co-operating with the society in the advancement of professional knowledge. Addressing the manufacturers, Mr. Allen said he felt there has been some neglect on their part in not developing artistic effect in heating goods, and he referred to the advances made in this direction in the plumbing trade. Heating fixtures, he said, should be made more harmonious with the other fixtures of a house. Radiators, for instance, have been improved.

Prof. J. H. Kinealy responded to the toast, "The Ladies." Professor Kinealy told how he once attempted to please the ladies by proposing "our wives and our sweethearts, may the one be the other," but said instead, "our wives and our sweethearts, may the one never meet the other." Professor Kinealy said this was the first occasion that ladies had ever been present at one of the society's banquets. "The ladies," he said, "do much to make a success of these meetings. They keep us in at night, and get us up early to attend to the work before us. The ladies not present give their husbands permission to come, and the Chicago ladies send their husbands to take care of us. Gentlemen, the ladies! May they always be with us!"

R. S. Thompson was then called upon to speak on "Hot Air." Mr. Thompson said that in connection with hot air and the place for holding the midsummer meetings, it was only necessary to suggest to a Chicago man that St. Louis is forging to the front. Mr. Thompson said the business of the society was the securing of cold facts, and he was pleased to see the progress that was being made in this direction.

Andrew Harvey spoke for the manufacturer, and said he would gladly endorse the proposition of holding the midsummer meetings in Chicago but for the fact that he could not believe that Chicago was ever in need of artificial heat, judging by the temperature of the city during the previous two days.

John A. Connolly spoke for "The Steam Fitter," and Frank K. Chew for "Our Hosts." Mr. Chew told how a heating engineer in San Francisco, whose library had been destroyed by the fire, felt that he could not do business again until he had secured a new set of the American Society's Proceedings.

F. F. MacNichol created much merriment by singing a song to the tune of "Tammany," which contained several "local" allusions. The evening's entertainment was brought to a fitting close by a proposal from William G. Snow for three cheers for the Illinois members. They were given with enthusiasm, and this broke up the gathering.

Use of Alcohol as a Fuel

The efforts of the commercial and industrial interests of the country to adjust their minds for a contemplation of the immense possibilities for commercial development which are opened up by the denatured alcohol bill are just beginning. It seems to be common-opened up by the denatured alcohol bill for general use foretells a virtual revolution in manufacturing processes generally.

The possibilities of alcohol as a household fuel are engaging the attention of a large class of manufacturers. It is estimated that grain alcohol can be produced and sold at 15 cents a gallon at a fair profit. This estimate is based on the experience in such countries as Germany, where it is a staple product at present. Germany already has a successful lamp burner, with a Welsbach mantle, which gives a most satisfactory light from alcohol, and when alcohol is once introduced as a household lighting agent, some way is certain to be found for its use in cooking stoves, where it would have many advantages, because it radiates so little heat, produces no soot and is free from the disagreeable odors so unpleasantly associated in the mind with kerosene and gasoline.

Referring again to its use in the production of power, it is to be said to the credit of alcohol that it works admirably in all respects, giving very clean combustion, producing little wear and tear on the engine, and in other ways recommends itself so highly, that all arguments seem to be in favor of it.

THE HEATING AND VENTILATING MAGAZINE

PUBLISHED MONTHLY AT
1123 BROADWAY, NEW YORK
BY THE
HEATING AND VENTILATING MAGAZINE CO.

A. S. ARMAGNAC, EDITOR

European Representative:
AMERICAN PUBLICATION BUREAU, 58 Manor Park Road, Harlesden, London, N. W.

Subscription, - - - - - - $1.00 per year
Foreign countries, - - - - - 1.50 " "

Manuscripts submitted for publication must in every case be accompanied by postage; otherwise they will not be returned.

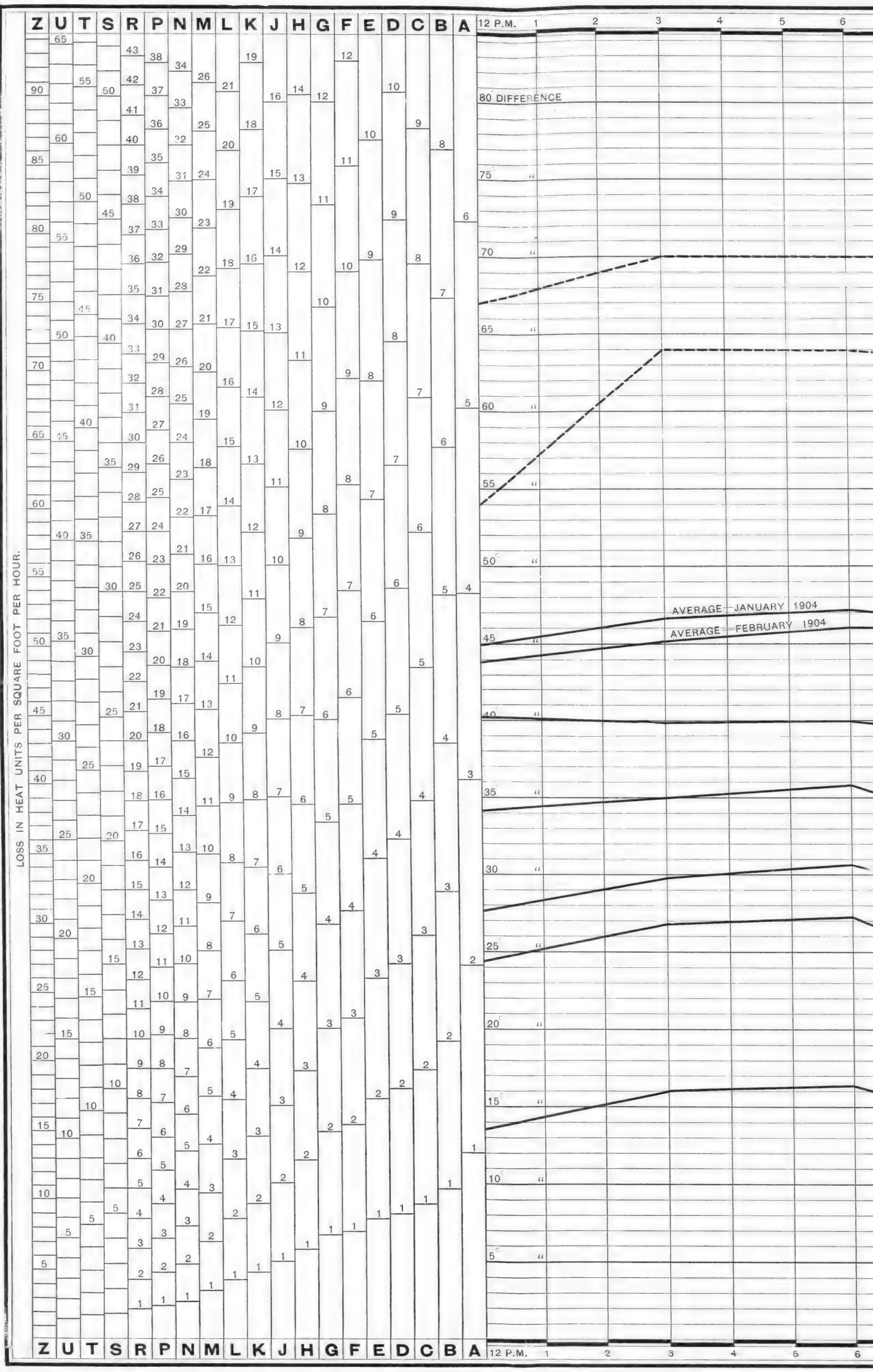
WE feel fortunate in being able to present to our readers, with this issue, a supplement containing a scale of heat losses, plotted by Mr. Reginald Pelham Bolton, of New York, which shows, in diagram, not only the heat losses through the various building materials at a difference of 70 degrees between inside and outside temperatures, but also the heat losses at all the intermediate outside temperatures. On the same chart Mr. Bolton has plotted the average temperature variations for each month of the heating season of 1903-4 in New York City, together with a record of the temperature on the two coldest days of that winter.

It is well known that in very few parts of the country, indeed, is there a constant outside temperature, during the winter, of zero or under, either day or night. In and about New York a careful study of the official weather bureau records for ten years past reveals the fact that the curve of minimum temperature during the heating season seldom falls below 20 degrees and often goes above 30 degrees. In studying this ten years' record, Mr. Bolton has found that the winters of 1903, 1904, and 1905 represented very fairly the mean as well as the minimum winter temperatures to be expected in this locality; the fluctuations of the season of 1904-5 have been plotted by Mr. Bolton, and accompany his article on the subject in this issue.

THE importance of this investigation and the very great value of such a heat loss chart as that prepared by Mr. Bolton will be recognized by everyone engaged in figuring heating requirements for buildings. Incidentally, the weather bureau records explain why it is possible for heating contractors to trim the specifications of the designing engineer who is working on a zero to 70 degree temperature basis, and yet secure a heating system that will give satisfactory results during 200 days out of 210.

AS regards large heating plants, Mr. Bolton's investigation would certainly seem to show that the engineer who designs his apparatus to heat from zero to 70 degrees is going to have a system whose capacity is out of all proportion to the conditions it will have to meet. In the New York Central terminal, now building, for the mechanical equipment of which Mr. Bolton is the consulting engineer, it has been found, for instance, that a variation of 1 degree Fahr. may represent the work of 150 boiler horse power. In the face of such a situation, it is apparent what a tremendous saving may be made when practically an exact knowledge is had of the weather

THE HEA



W. V. COLLINS, Del.

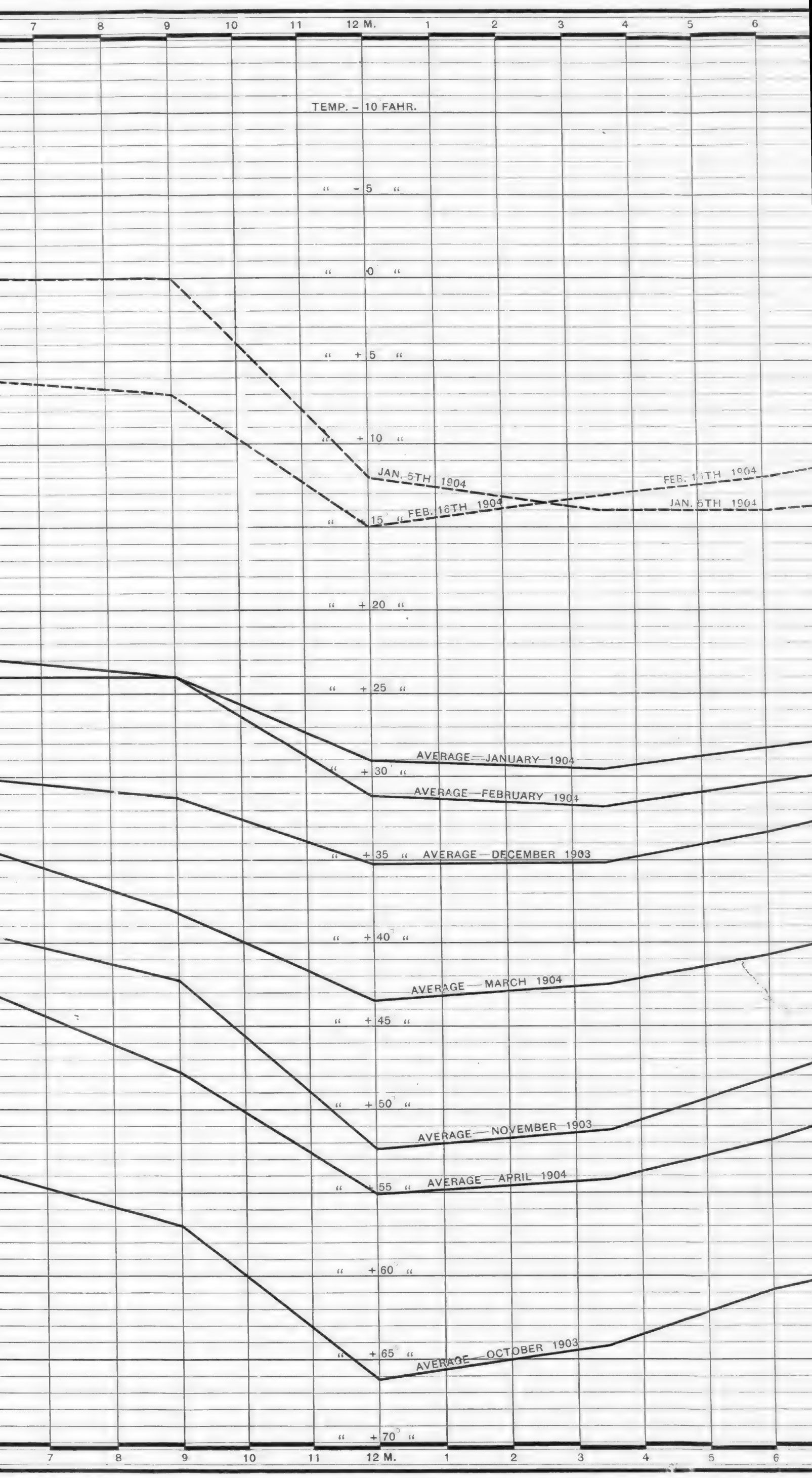
A—Wooden Beam Floor
B—Wooden Beam Ceiling
C—40 in. Brick Wall
D—Fireproof Floor
E—36 in. Brick Wall
F—Fireproof Ceiling
G—32 in. Brick Wall
H—28 in. Brick Wall
J—24 in. Brick Wall
K—20 in. Brick Wall
L—16 in. Brick Wall
M—12 in. Brick Wall
N—Door
P—8 in. Brick Wall
R—Double Window
S—Double Skylight
T—4 in. Brick Wall
U—Single Window
Z—Single Skylight

Scale of Heat Losses T

With Diagram of

Supplement to
TING AND VENTILATING MAGA
Vol. III., No. 8, August, 1906

Copyright, 1906, by A S. Armagnac. All rights reserved. This chart must not be reproduced without permission.


7 8 9 10 11 12 M. 1 2 3 4 5 6
TEMP. – 10 FAHR.
" – 5 "
" 0 "
" + 5 "
" + 10 "
JAN. 5TH 1904
FEB. 16TH 1904
" + 15 "
FEB. 16TH 1904
JAN. 5TH 1904
" + 20 "
" + 25 "
AVERAGE—JANUARY 1904
" + 30 "
AVERAGE—FEBRUARY 1904
" + 35 " AVERAGE—DECEMBER 1903
" + 40 "
AVERAGE—MARCH 1904
" + 45 "
" + 50 "
AVERAGE—NOVEMBER 1903
" + 55 " AVERAGE—APRIL 1904
" + 60 "
" + 65 "
AVERAGE—OCTOBER 1903
" + 70 "
7 8 9 10 11 12 M. 1 2 3 4 5 6

Through Building Materials at Different Ou

the Temperature Variations from 70° Fahr. Interior Temperature, for the Season of 1903-1904 in New Y

Prepared for The Heating and Ventilating Magazine by Reginald Pelham Bolton, M. E., 527 Fifth Avenue, New York City

HOW TO USE THE SCALE:

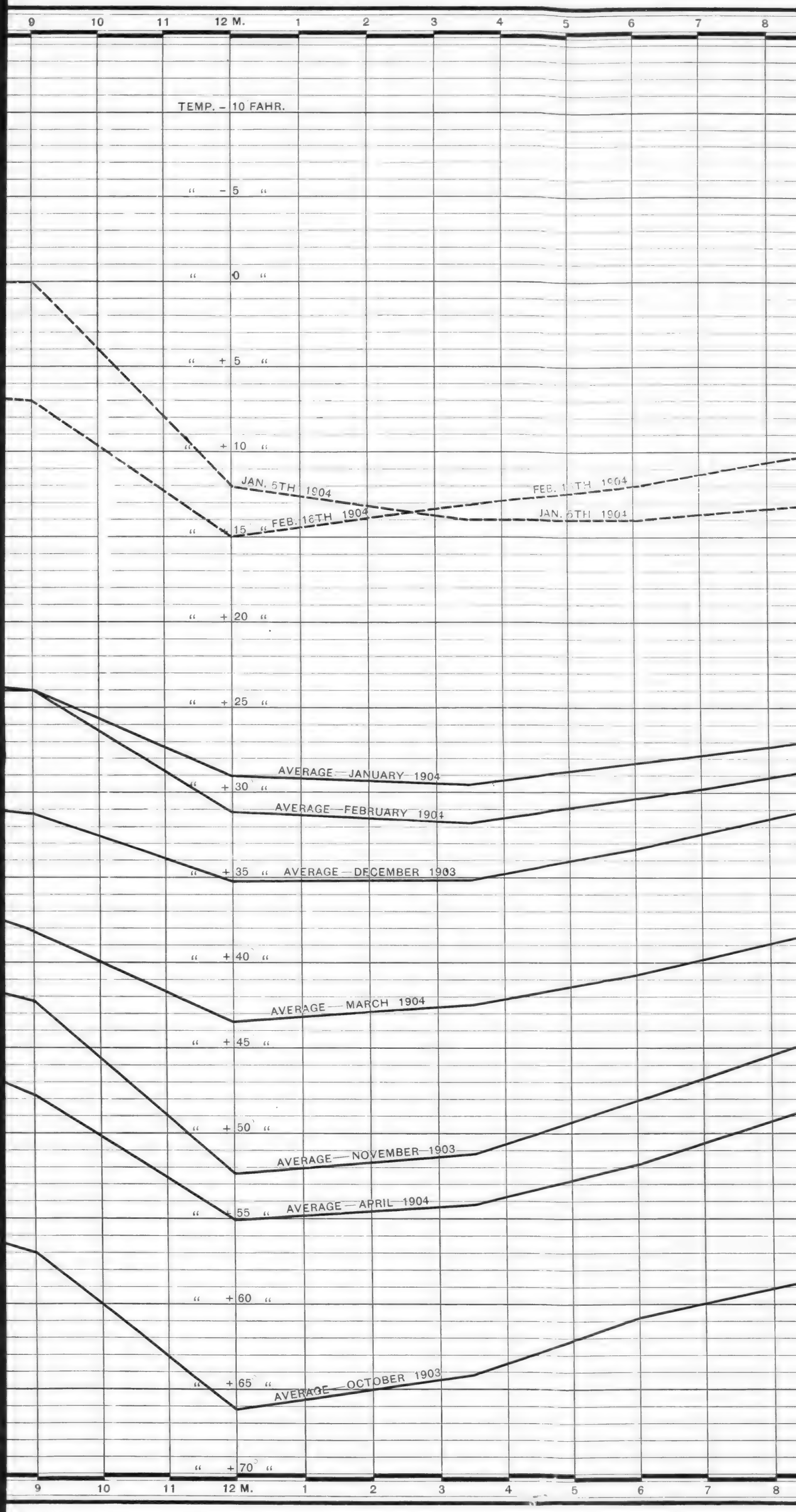
A rule laid across the diagram will enable the reader to ascertain, at a glance, the rate of heat loss, at any hour of the twenty-four, in any month of this average season, through any material, and it is only necessary to multiply the exposed areas of different constructions by the number of heat units thus scaled off.

Supplement to

AND VENTILATING MAGAZIN

Vol. III., No. 8, August, 1906

A S. Armagnac. All rights reserved. This chart must not be reproduced without permission.



Building Materials at Different Outside T

riations from 70° Fahr. Interior Temperature, for the Season of 1903-1904 in New York City

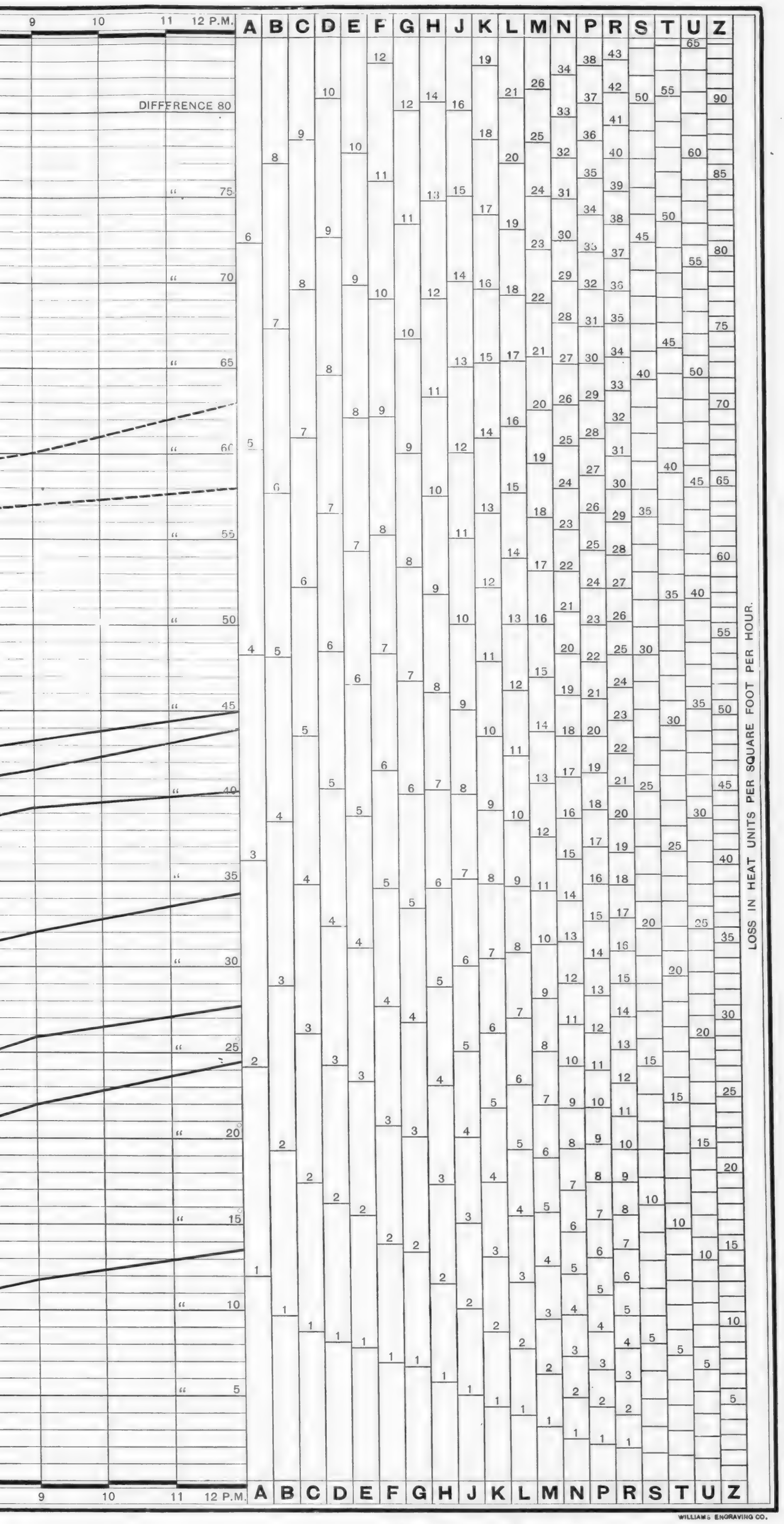
and Ventilating Magazine by Reginald Pelham Bolton, M. E., 527 Fifth Avenue, New York City

---

HOW TO USE THE SCALE:

r le laid across the diagram will enable the reader to ascertain, at a glance, the rate of heat loss, at any hour of the twenty-four, in any month of this average season, through any material, and it is only necessary to multiply the exposed areas of different constructions by the number of heat units thus scaled off.

E



WILLIAMS ENGRAVING CO.

Temperatures

A—Wooden Beam Floor
B—Wooden Beam Ceiling
C—40 in. Brick Wall
D—Fireproof Floor
E—36 in. Brick Wall
F—Fireproof Ceiling
G—32 in. Brick Wall
H—28 in. Brick Wall
J—24 in. Brick Wall
K—20 in. Brick Wall
L—16 in. Brick Wall
M—12 in. Brick Wall
N—Door
P—8 in. Brick Wall
R—Double Window
S—Double Skylight
T—4 in. Brick Wall
U—Single Window
Z—Single Skylight

conditions from day to day and from month to month, as they may be expected to occur, based upon the fluctuations during the previous 10 years. The investigation presented herewith is but a portion of that undertaken for determining the daily and hourly heating load of the New York Central terminal buildings and the variable amounts of exhaust steam for heating purposes that may be obtained. An account of this comparison will also be presented in our columns when the work of computation is completed.

THE heating of steamships and other vessels is a class of work that would interest an increasing number of heating contractors if they were more familiar with the conditions to be met. We print, in another part of this issue, an exhaustive article on steamship warming which was read just recently before the British Institution of Heating and Ventilating Engineers. This paper not only describes the various methods of heating vessels, but also treats in an interesting manner the difficulties that most commonly occur in steamship warming, difficulties that are entirely unknown in heating work on land. The author, Mr. Charles R. Honiball, calls attention, for instance, to the effects produced by the pitch and roll of a vessel, especially in rough weather, which not only seriously interfere with the circulation and drainage of the system, but also cause strains and stresses in the pipes and fittings. The motion of the vessel would, of course, prove a more serious problem in the case of a hot water system where it is important to provide sufficient rise and fall in the flow, return and drain pipes. While hot water systems are seldom fitted on passenger vessels, they are largely used on private yachts, for the reason, as Mr. Honiball explains, that when warmth is most needed, the vessel is generally out of commission and the main boiler is, therefore, shut down. The author illustrates the methods generally adopted for heating vessels by hot water, a forced circulation being usually required.

TWO of the preliminary reports of special committees, presented at the semi-annual meeting of the American Society of Heating and Ventilating Engineers in Chicago last month, were made up largely of questions concerning information which the committees are seeking. One of these reports, on the subject of hot water heating for small buildings, was printed in our July issue, and the other, on steam heating data for small buildings, will be found in this issue. We understand that answers to these questions will be welcomed both from non-members and members of the society who will give the committees the results of their experience upon the various points raised. The third committee, which is endeavoring to establish standard sizes for steam mains and returns, would also be pleased to receive information along these lines. The chairman of the committee on hot water data is Mr. James Mackay, 1200 Michigan avenue, Chicago, Ill.; the chairman of the committee on steam heating data is Mr. J. J. Blackmore, 88 Beekman street, New York, and the chairman of the committee on steam mains and returns is Mr. James A. Donnelly, 132 Nassau street, New York.

The Warming of Steamships*

By Charles R. Honiball, Liverpool, England

The papers read and discussed by the members of this institution during the past few years have been devoted, mainly, to problems connected with land installations. The author hopes this short paper dealing with installations erected on board passenger, pleasure vessels and warships, may prove of interest to the members generally.

Motion of Vessel a Prime Factor

The designing of a successful warming installation of a vessel may appear to present no difficulties other than would be encountered in the designs for an hotel or public institution. A closer inspection of the conditions under which a ship plant is required to efficiently fulfil its functions will, however, reveal many difficulties and problems not incidental to land installations. Of these problems, perhaps the most important are the effects produced by the complex motion of the vessel, especially in rough weather, which have not only a prejudicial influence upon the circulation and drainage of the heating medium, but also set up strains and stresses in the pipes and fittings of the plant which are still further intensified by the hogging, sagging and distortion of the hull by a heavy sea or waves of varying pitch lengths.

To ensure a natural circulation or drainage of heated water through pipes, it is important that due regard be made to ensure sufficiency of rise and fall in the flow, return and drain pipes. This can be accomplished and maintained with certainty and precision in land jobs, but in marine work, owing to the varying trim and motion of the vessel, it becomes a matter of great difficulty, if not impossibility. The system proposed to be installed on a vessel must, therefore, be capable of producing satisfactory results under the aforementioned adverse conditions. For marine work, where compactness is of vital importance, weight at a premium, cleanlines and convenience are prime objects and safety is paramount, it will be conceded that the designing of such installations call for the exercise of skill, judgment and close atention to details, combined with high-class workmanship.

The systems of warming now installed on vessels, warships and private yachts may be classified as follows:

1. By the radiation of heat from stoves and open fires.
2. By the distribution of steam through pipes, radiators, etc.
3. By the circulation of hot water through pipes, radiators, etc.
4. By the distribution of warm air.
5. By electrically-heated radiators and convectors.

*Paper read before the British Institution of Heating and Ventilating Engineers, Bath, England, June 19, 1906.

Heating by Stoves

From time immemorial open fires and stoves have been employed for warming the living spaces and cabins of vessels. In these days, while stoves have been largely superseded by steam, hot water and electrically-heated devices, they are by no means extinct. On sailing vessels they are very common, while on many of our most modern private yachts and passenger vessels will be found elaborately designed stoves and fireplaces, fitted, principally, to give a homelike appearance to the room more than for actual warmth.

On H. M. warships, until recently, stoves and open fires were universally employed for warming the admiral's and captain's apartments, wardrooms, gunroom and crew spaces, those for the latter being primarily intended for drying damp clothing. The old royal yacht, "Victoria and Albert," was warmed by stoves and open fires burnt in nandsome fireplaces. It is interesting to know that stoves were fitted on the Polar ship, "Discovery," and, for magnetic reasons, many of them had brass casings lined with firebrick; but, needless to state, the casings rapidly burnt out and had to be replaced.

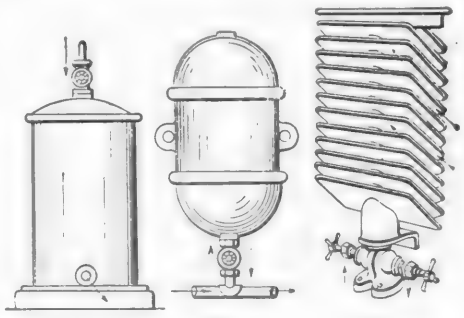


FIG. 1. FIG. 2. FIG. 3.

FIG. 1. TYPE OF CAST IRON HEATER. FIG. 2. SAME TYPE DESIGNED TO FIT AGAINST PARTITION. FIG. 3. HEATER PROVIDED WITH INCLINED GILLS.

Steam Heating

Steam heating systems, for many years, have been employed on vessels for warming the cabins and living spaces in cold weather. In large passenger vessels this is usually done by leading copper steam pipes along the passage-ways between the cabins. The steam pipes vary in size, even on the same circuit. The normal diameter is determined chiefly by the steam pressure, length of service, and the number of steam radiators and heaters to be supplied in addition to the heat which the pipes themselves have to dissipate to warm the spaces through which they pass; generally speaking, pipes of 1¼ in. to 1½

in. bore are found to be of ample capacity. The branch pipes to and from radiators in side passages and cabins are rarely larger than ½ in. bore (except in special cases); ¼ in. to ⅜ in. are the sizes most commonly fitted. When the steam pipes are required to provide a larger amount of heating surface than would be afforded by pipes of the normal diameter, they are

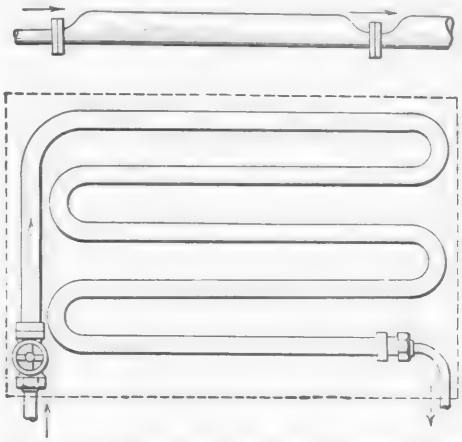


FIG. 4. PIPE HEATER, SHOWING REDUCTION OF PIPES AT JOINTS TO PERMIT OF SMALL FLANGES.

often enlarged to 2½ in. or 3 in. diameter, for such portions of their length as may be required. In such cases, the pipes are often locally reduced at the joint, so as to permit of small flanges and to reduce the stress on the connecting bolts; the joint being arranged as shown in Fig. 4, so as not to restrict the flow of condensed water. In the saloons and other public rooms the heating pipes are fitted around two or more sides of the room, and very frequently under the dining tables. All the pipes are most usually carried a few inches above the deck level, and are protected by ornamental gratings of cast-iron or brass. Radiators or heaters when required in the passagewavs, are usually fitted in recesses formed in the bulkhead, or otherwise protected by casings. Stop-valves are fitted to control the inlet and outlet branches of heaters. In many ships the valves for stateroom heaters are placed outside the rooms. The installation is divided usually in several port and starboard circuits, each circuit being controlled by stop-valves on both steam and exhaust pipes. Steam from the donkey and main boilers, or from the auxiliary steam pipes, is distributed through the pipes. The condensed water from the pipes, radiators and heaters is led frequently by a circuitous route to the main exhaust pipe, thence to the auxiliary condenser and boiler feed tanks.

FLOW OF STEAM UNAFFECTED BY MOTION OF VESSEL

The early adoption of steam as the heating medium was, no doubt, due to the fact that its distribution was practically unaffected by the motion of the vessel, while the resistance offered to the flow of the steam by bends, dips, differences of pipe levels, and other features incidental to the complex arrangement of piping which obtains on every vessel is very small. The system was particularly effective if the condensed steam from the pipes and radiating devices were permitted to blow direct into the atmosphere, as was customary years ago.

DIFFICULTIES IN CONNECTION WITH HIGH STEAM PRESSURES

With the introduction of high-steam pressures in the boilers came the necessity of insuring a feed supply of pure water for the boilers. Hence it became imperative to prevent the waste of condensed steam from the auxiliaries, such as pumps, cooking apparatus, heating pipes, etc., since any deficiency arising from such must be made good by the ship's evaporators and distillers at much expense in steam, coal, etc.

In consequence of this necessity for returning the condensed water from the heating pipes and radiators to the boiler feed tanks, arose the many difficulties incidental to the working of steam heating installations. As already pointed out, the motion of the vessel has a prejudicial in-

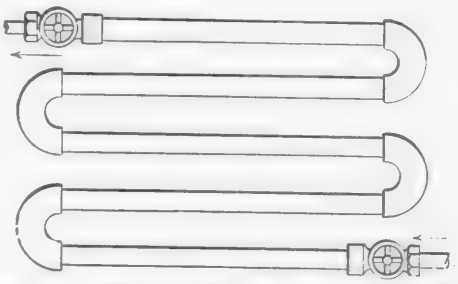


FIG. 5. COMMON TYPE OF SHIP'S HEATER, MADE OF WROUGHT-IRON OR COPPER TUBES.

fluence on the flow of water in pipes; and it will be found upon careful examination that the largest proportion of broken pipes and fittings, leaky joints, etc., is mainly due to the water-hammer effects of the condensed steam in the pipes, more especially if the runs of the pipes have many turns, bends, dips, etc., which is commonly the case on shipboard. In addition to these there is also the effect of expansion due to the high surface temperature of the pipes and fittings, the strains due to the vibration and distortion of the vessel, all of which cause excessive wear and tear, far in excess of that produced in land installations.

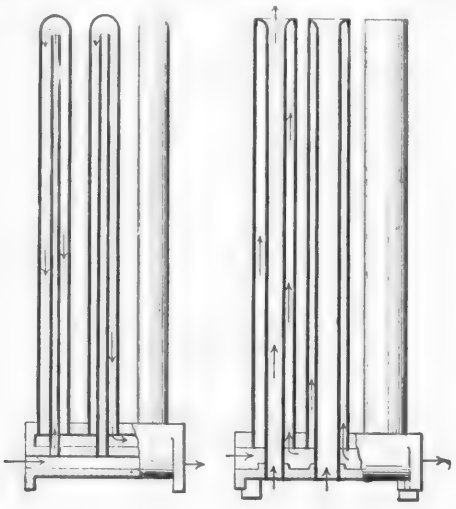
STEAM AND DRAIN PIPES MADE OF COPPER

For the foregoing reasons, and also for safety, the steam and drain pipes are most usually of copper, with brazed bolted flanges or union couplings at the joints,

all of liberal proportions and strength. All tees and crosspieces, bulkhead connections, and other fittings peculiar to marine installations, such as stop-valves, etc., are of gunmetal. Notwithstanding the employment of best material and workmanship, the cost for repairs on many of our large vessels runs into a considerable amount per annum.

THE STEAM HEATED ROYAL YACHT "VICTORIA AND ALBERT"

The new royal yacht "Victoria and Albert" is steam heated throughout. In designing the installation, safety was made the primary consideration. All the steam radiators are of the pattern shown in Fig. 8, and are constructed of solid drawn copper tubes and gunmetal. Each heater was tested after construction to 400 lbs. by water pressure. The steam supply is taken from the main boilers, which work at 192 lbs. pressure. The steam is passed through a reducing valve and delivered into a cylindrical receiver at 15 lbs. pressure. Safety valves, set to blow off at 20 lbs. pressure, are fitted on the receiver,



FIGS. 6 and 7 THE ROYAL YACHT "VICTORIA AND ALBERT" IS FITTED WITH RADIATORS LIKE THOSE SHOWN IN FIG. 7.

and thereby prevent any increase in pressure above that amount in the heating pipes and radiators. The steam and condensed water pipes are 1½ in. bore, having heavy flanged joints, each secured by ⅞ in. mild steel bolts and nuts. All the flanged joints are metal to metal, scraped and fitted, steam and water-tight, and when put together—dry-tested by water at 400 lbs. pressure. The copper pipes were specified to have a bursting pressure of 1,800 lbs. per square inch. The branch pipes to each radiator are ⅜ in. bore. All tees and crosspieces and other connections are of gunmetal with heavy flanges; no brazed branches were allowed on any pipe.

The cabins are built on a special form of channel bar. Between the flanges of these bars the steam mains are fitted; a heavy brass grating being placed in front to protect the pipes and admit a free circulation of air. The pipes are unlagged. After the pipes, fittings and radiators were installed, a water test pressure of 400 lbs. pressure was made; after which all joints were opened up, cleaned and put together again, then the whole installation tested to 40 lbs. pressure. The steam radiators in the royal apartments are 30 in. high, are fitted with 4 tubes, and are of the pattern shown in Fig. 8. They are enclosed in highly-finished wood casings, with brass gratings in front. The apart-

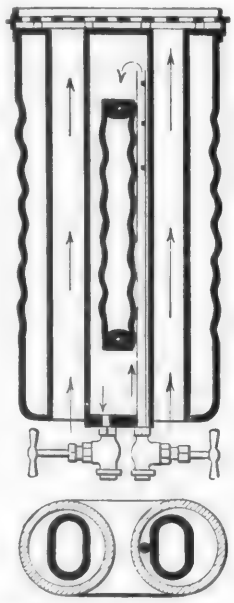


FIG. 8. SECTIONAL VIEW OF HEATER SIMILAR IN PRINCIPLE TO FIG. 7.

ments are 11 feet high, and the radiators casings are carried up 5 feet from the deck, the top of each being open for the discharge of the warmed air circulating through them. The casings and gratings are decorated to match the furniture of each room.

Similar type radiators are fitted in the passage-ways between the staterooms, and in all the principal rooms throughout the vessel, and the ordinary type of radiator in the crew spaces. Stop valves are fitted to control each pipe circuit and also the steam inlet and outlet branches of each radiator. All valves and fittings are of ample strength to withstand the full boiler pressure of 192 lbs. per square inch, should they inadvertently be subjected to that pressure.

TYPES OF STEAM RADIATORS USED IN MARINE WORK

Figs. 1 to 9 illustrate types of steam heated radiators now fitted on board ship. Fig. 1 shows a type of cast-iron heater which has been fitted on ships for many

years, and is still popular. The steam is admitted at the top, the condensed water flowing away at the bottom. Fig. 2 is of similar design, but arranged to fit against a divisional bulkhead or partition. This type is usually fitted on the one-pipe system, and has only one stop valve. In Fig. 3 type the heater is provided with a number of inclined gills, and is arranged to fit against a bulkhead, or supported on deck as may be required. The steam and exhaust valve are of the combined pattern.

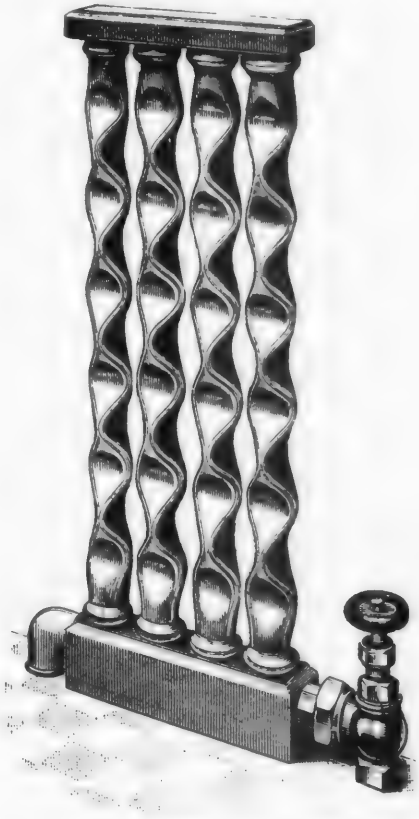


FIG. 9. TYPE OF RADIATOR USED EXTENSIVELY ON BOARD SHIP, FOR BOTH STEAM AND HOT WATER.

The steam is delivered by an internal tube within a few inches of the top, and, when condensed, drains away at the bottom. This pattern is very popular in some ships. On the "Carmania" and also the "Coronia," a large number of these heaters are installed in the passageways between the first-class staterooms of each ship. They are usually protected by a wire guard. Fig. 4 is the pipe heater, and is one of the earliest forms to be employed on board ship. They are made both in iron and in copper. To provide a free passage for the flow of condensed steam and permit of the use of small flanges, the pipes are usually reduced at the joints as shown. Figs. 4 and 5 are very common types of ship's heaters, and are constructed of wrought-iron or copper tubes. Small sizes are fitted in the staterooms, and larger sizes in the vestibules and passageways between the staterooms, and are either enclosed in cases or fitted into recesses formed in the bulkheads.

Fig. 6 is also largely employed for vestibules and passageways, and consists of a base of cast-iron provided with steam and exhaust passages, which communicate with one or more rows of vertical pipes, the arrangements of the several parts being as shown. The outer tubes are generally made from 1 in. iron pipe, the upper end being closed, the lower open end screwing into the base. The inner or steam pipe is ¼ in. iron, and is carried within a few inches of the top of each of the outer tubes.

Fig. 7 is the type of heater employed on the royal yacht. This type was introduced about the year 1887, and was then fitted on many of the American liners. They are constructed of solid drawn copper tube, the base being of cast brass, all joints being hard brazed. The outer tubes are usually 2¼ in. in diameter, the inner 1¼ in. Steam is admitted into the annular space formed between the inner and outer tubes, the air being displaced by an eight-inch bore pipe fitted in the annular space. When the radiator is heated, air freely circulates through the inner tube.

Fig. 8 is a sectional view of a heater similar in principle, but introduced more recently. In this type the outer tubes are spirally corrugated, the top and bottom ends of the outer tubes opening into a common chamber at each end, and are usually made in two tube sections. They are constructed of cast-iron, each section being formed in one piece.

Fig. 9 type of radiator is extensively employed on every class of vessel, both for steam and water. Its construction, characteristics and advantages being so well known no further description is required.

Hot-Water Systems

Hot-water systems of warming, though largely employed on private yachts, are but rarely fitted on passenger vessels. The adoption of the system for yacht work is, no doubt, due to the fact that when warmth is most needed the vessel is generally out of commission. During this period the main boiler is shut down, and the warmth which it imparts to the vessel when under steam is not then available. Hence, unless some means are adopted to maintain a moderate temperature throughout the ship, dampness will ensue, with consequent deterioration and damage to the furniture, upholstering and other costly appointments common to such craft. Though the installation is primarily intended for warming the vessel when out of commission, and during the winter, it must, however, be designed to work effectively when the vessel is in

commission and cruising. The prejudicial influence on the circulation due to the motion of the vessel has already been pointed out, and means must, therefore, be employed to counteract such effects. For this reason the vertical system of piping is the one most commonly adopted for yacht work, the installation being divided into as many vertical flow and return risers to the radiators as the work will permit. When carefully proportioned and installed, this system will give tolerably good results, even in bad weather.

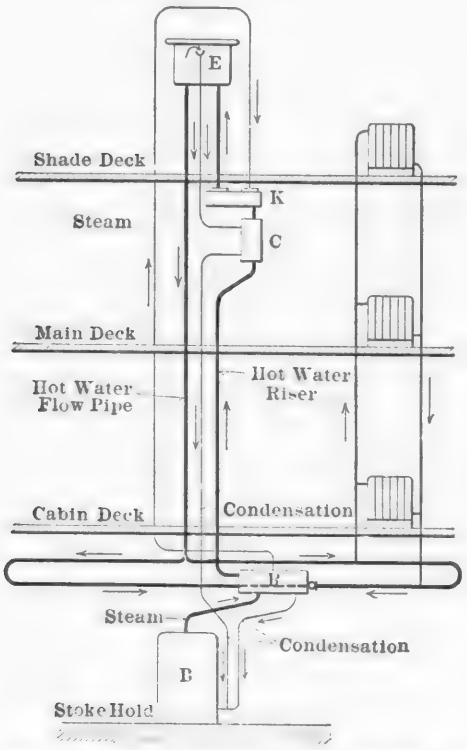


FIG. 10. RECK SYSTEM OF HOT-WATER HEATING, FITTED ON BARON DE FOREST'S STEAM YACHT "HONOR"

A general description of two distinct systems of low-pressure hot-water installations now at work on steam yachts will prove of interest, and serve to illustrate this class of work.

RECK SYSTEM AS INSTALLED ON THE STEAM YACHT "HONOR"

I will describe the "Reck" system of hot-water heating fitted on Baron de Forest's steam yacht "Honor" by a well-known Paisley firm with an office in London. The general arrangement of the apparatus is shown diagrammatically in Fig. 10.

The arrangement consists of a vertical steam boiler, *B*, fitted in the stokehold, which works at a pressure of about 5 lbs. per square inch. The steam is lead first into the casings of the reheater *R*, which is fixed beside the boiler, and in the recess under the ash discharge pipe. The reheater is on the level of the return pipes of the heating apparatus, and the return water passes through its tubes before rising to the circulator *K*. The circulator *K*, condenser *C*, and expansion tank *E*, are fitted up inside the casing at the foot of the funnel, at such a level that the bottom of the tank is about 2 ft. above the top of the highest radiator. This casing is, I may mention, higher than in the usual type of steam yacht, as there is on the "Honor" a shade deck over the whole vessel.

The steam and water pipes from the reheater to the circulator, and the condensation pipe from the condenser to the boiler, are all carried down to the stokehold together. The steam pipe is 1¼ in., and the hot-water pipe 1½ in. diameter, and the condensation pipe ¾ in. diameter.

From the expansion tank the main flow-pipe, 1½ in. diameter, is carried down alongside the other pipes mentioned above into the stokehold, where it divides into two 1¼ in. pipes, at the level of the cabin deck. These two 1¼ in. pipes run fore and aft, through the shaft tunnel and through a passage between the water tanks forward, and they diminish in size as the various branches are taken off, their size at the extreme ends being ½ in. The return-pipe, which is always of the same size as the flow-pipe, is led along the same lines as the flow-pipe.

There are 18 sets of vertical flow and return pipes throughout the vessel connected to the radiators, all ½ in. diameter. They are all behind the paneling, and being so small are easily disposed of. The 33 radiators are mostly of cast-iron, but in some cases of plated copper. These are fitted in practically every cabin and room in the vessel, and are all supplied by the two 1¼ in. pipes mentioned above.

This installation, I am given to understand, can be heated throughout within an hour, and the heat is equally well distributed, no matter what may be the position of the ship. The reduction of pressure in the circulator is such that levels become of little moment, and when the ship gets out of trim, there is still as good a heat at the low end as at the high end. This is one of the difficulties incidental to both steam and water heating systems, as when levels are taken in the dock, and the apparatus worked well at the time, the levels would often alter considerably when the vessel was in commission, and would greatly retard the working of an apparatus which depended entirely on gravity for its circulation.

(*To be concluded in the September number*).

TRADE AND MISCELLANEOUS NOTES

Deaths

Francis Worcester, St. Louis, Mo., died June 21 last. Mr. Worcester was for over 25 years connected with the National Tube Works Company.

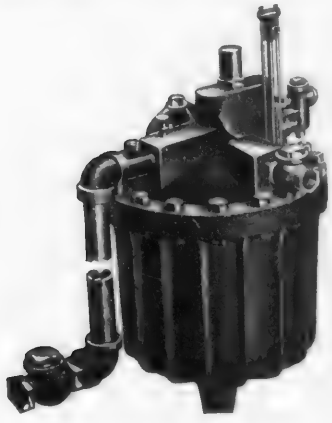
Trade Literature.

Asbestos packings to meet the tendency of modern steam plants to use higher steam pressures than heretofore will be described in a new catalogue that will be issued shortly by the H. W. Johns-Manville Company, New York. For withstanding high pressures and high temperatures packings made of asbestos fiber are preferred to those made of rubber or organic material and in this connection the "J-M" asbestos packing are made in a variety of forms to meet different requirements and conditions. Among the advantageous features of these packings are their high heat resisting properties and durability. They have also been found very pliable and conform readily to irregular surfaces. They are made entirely without rubber or organic materials. We understand that copies of this catalogue will be mailed free upon request.

Bundy steam and water radiators including the new patterns in the Columbia line of sectional radiators are illustrated and described in a handsome catalogue issued by the A. A. Griffing Iron Company, Jersey City, N. J. The catalogue contains detailed tabulated data regarding the efficiencies of the different styles of radiators, presented in convenient form for quick reference. The catalogue also shows radiators designed for use on shipboard, a subject that will arouse interest among steam fitters on account of the article published on another page of this issue on the subject of the warming of steamships. The remaining portion of the catalogue is given up to a description of the Bundy heating specialties, such as cast iron wall boxes, radiator valves, union elbows, expansion tanks, pipe hangers and Bundy rex automatic air valves. Size 6x9 inches (standard). Pp. 68.

Some Phases of the Feed-water Heater Problem is the title of an article by Walter E. Harrington appearing in the *Street Railway Journa l*of July 22 and reprinted by Warren Webster & Company, Camden, N. J. Mr. Harrington has some interesting things to say on the important subject of boiler room economies, and especially on those to be obtained through the proper use of boiler auxiliaries, including feed-water heaters. Mr. Harrington makes a strong argument in favor of the open or direct contact type of heater over the closed heater in improving the quality of the feed-water, both through the saving of condensation and in overcoming the troublesome features of carbonates of lime and magnesia deposits. In the Webster "Star Vacuum" feed-water heater, purifier, filter and receiver which is illustrated and described in a recent catalogue, issued by Warren Webster & Company, many of the ills in connection with feed-water heaters have been successfully solved.

"Keystone" Hair Insulator, an insulation that positively deadens sound, has been placed on the market by the H. W. Johns-Manville Company, New York, and



The Albany Return Steam Traps

have been the **STANDARD** for over **THIRTY-TWO YEARS.** For returning water under pressure to the boiler, they will perform this duty fully as well, and in many cases better than the so-called steam loop.

Send for circulars A, B, C and D.

MANUFACTURED BY

ALBANY STEAM TRAP CO., ALBANY, N.Y.

FREDERICK TOWNSEND, PRESIDENT — JAMES H. BLESSING, GEN. M

is so constructed that sound cannot penetrate it. It is described as especially useful when placed between walls for keeping in the warmth and excluding the cold. This insulation is vermin proof, inodorous and inexpensive.

Consolidated Engineering Company, Chicago, Ill., blotting-pad with reference to the Van Auken system of vacuum heating. The company announces the appointment of Thomas E. Keegan as representative for Indiana, Ohio, Kentucky and Tennessee, with headquarters at Louisville.

United States Heater Company, Detroit, Mich., catalogue C, general catalogue issued June, 1906. Size 5x8. Pp. 118.

D. T. Williams Valve Company, Cincinnati, Ohio, folder describing Cookson low pressure steam traps.

Holland Radiator Company, Chicago, Ill., 32-page folder describing Holland radiators.

New Firms.

Clark Engineering Co., Newark, N. J., is the name of a new firm which has opened a heating business at 22 Clinton street. George W. Clark is in charge of the business.

Ithaca Ventilating Co., Ithaca, N. Y., has opened a business to manufacture apparatus for an exhaust system of ventilation to be used in connection with furnaces or steam and hot water heating systems.

Pavey & Baumann, South Bend, Ind., have started a steam and hot water heating and plumbing establishment at 232 North Main street.

Metal Construction Co., Des Moines, Iowa, is the name of a new firm comprising the retail plumbing and heating business of the L. H. Kurtz Company, the sheet metal business of the Grahl-Peterson Company, and the business of the Waterloo Plumbing and Heating Company. The company is incorporated with a capital of $25,000. President, L. C. Kurtz; manager, H. H. Grahl; treasurer, M. J. Corcoran. The new firm will do a plumbing, heating and ventilating business, as well as sheet metal work; also manufacture metal windows, cornices, skylights and slate and tile roofing

Business Changes.

Quay Engineering Company, 1125 Broadway, New York, consulting, designing and supervising engineers, is the new title of the Mannados Engineering Company at the same address

Manufacturers' Notes.

Kellogg-Mackay-Cameron Co., Chicago, Ill., extended an invitation to

We have opened for the accommodation of our friends an

EASTERN OFFICE AT

1135 Broadway, New York

HERBERT A. JOSLIN, Manager

Our TEMPERATURE REGULATING DEVICES

ARE THE MOST SIMPLE AND SENSITIVE
OF ANY ON THE MARKET

WRITE FOR CATALOGUE

THE NATIONAL REGULATOR CO.

W. W CURTIS
President

334 Dearborn St, CHICAGO

those present at the recent meeting of the Heating Engineers' Society to visit and inspect the company's new show rooms at Michigan avenue and Twelfth street. As this firm's new building was but a short distance from the society's headquarters, many took advantage of the opportunity to inspect the many examples that were equipped and displayed, representing the latest modern practice in heating, ventilating, power and vacuum work and sanitary plumbing. Many favorable comments were heard, both on the high quality of the goods examined and on the enterprise shown by the company in the arrangement of its display.

New Corporations

Gold Car Heating & Lighting Co., New York, has been incorporated with a capital of $3,000,000. The directors are: Edward E. Gold, Richard V. Voges, John C. Dixon, Henry J. Horn, Lucius E. Varney, Ambrose L. O'Shay and Edward J. Ronan.

O. C. Davis Co., Racine, Wis., has been incorporated with a capital of $6,000 to carry on a wholesale and retail plumbing and heating business. The incorporators are: O. C. Davis, A. J. Palica and A. H. Thomas.

Carson-Payson Co., Danville, Ill., has been incorporated with a capital of $25,000 to carry on a heating, lighting and plumbing business. The incorporators are: E. E. Payson, W. H. Carson and H. E. Callahan.

Cochenour & Hazen, New York, has been incorporated with a capital of $5,000 to deal in plumbing and steam fitting supplies. The incorporators are: William Cochenour, Charles Francis Hazen and Louis J. Frey.

Lally Co., San Francisco, Cal., has been incorporated with a capital of $100,000 to deal in steam fitting supplies. H. T. Lally is the president.

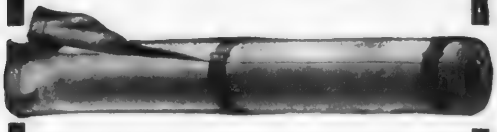
H. E. Thompson Manufacturing Co., Louisville, Ky., has been incorporated with a capital of $50,000 to manufacture the H. E. Thompson Patented Automatic Ventilating System.

East Side Heat, Light & Fuel Co., Bloomington, Ind., has been incorporated with a capital of $100,000. The incorporators are: Samuel R. White, Ora E. White and John J. Pitts.

Iron City Heating Co., Pittsburg, Pa., has been incorporated with a capital of $100,000. The directors are: James S. McVey, John McMurray and Ewald E. Kaschub.

National Ventilator Co., Chicago, Ill., has been incorporated with a capital of $5,000 to manufacture machinery and

Save 75% of Your Coal Consumption



by covering your pipes with "J-M" Asbestos and Magnesia Pipe Coverings. Made for all steam pressures. Reduces condensation to a minimum.

Write Nearest Branch for "Data Showing the Efficiency of Pipe Coverings."

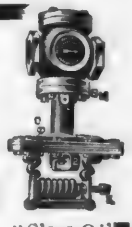
H. W. JOHNS-MANVILLE COMPANY

Manufacturers of Asbestos and Magnesia Products, Asbestos Roofings, Packings, Electrical Insulating Materials, "Noark" Fuse Devices, Electric Railway Supplies, etc.

New York	St. Louis	Minneapolis	Milwaukee
Pittsburg	Dallas	Chicago	Cleveland
San Francisco	Boston	New Orleans	Seattle
Los Angeles	Philadelphia	Kansas City	London

246

Foster Valve Specialties



"Class QH" Valve

"Class Q" Valve

It is never wise to put off until the last minute something which may be done at once. While considering ventilation look to the steam heating end.

Foster "Class Q" and "QH" Valves are adopted as standard valves for the Webster system of steam heating. These valves cannot be equaled for low pressure service, up to 15 pounds delivery.

"Class QH" has a small inlet, large outlet connections, which permit the use of a valve smaller than delivery pipe.

For details and prices write to the

Foster Engineering Co.,

NEWARK, N. J.

appliances. The incorporators are: D. E. Sullivan, D. I. Jarrett and Sarah Brennan.

Northwestern Pipe & Supply Co., Erie, Pa., has made application for articles of incorporation by W. H. Forster, vice-president and treasurer of the Hays Manufacturing Company; Otto S. Hitchcock, Walter C. Mallory and C. A. Hays. The new company is the outcome of the jobbing of pipe and fittings by the Hays Manufacturing Company, and will manufacture and sell iron and brass pipe and fittings, oil, gas, water and steam piping, plumbing and mill supplies, machinery and machinery supplies, tools, etc.

Little Miami Light, Heat & Power Co., Cincinnati, O., has been incorporated with a capital of $10,000. The incorporators are: Walter C. Taylor, Harlow N. Farrell, Henry L. Rockel, C. W. Spicer and Edward Schlesinger.

Woodstock Heating & Lighting Co., Woodstock, Ill., has been incorporated with a capital of $35,000 to supply water, heat and light. The incorporators are: George L. Murphy, W. S. McConnell and D. R. Joslyn.

Miscellaneous Notes

Henry S. Downe sailed July 21 from Liverpool for New York. Mr. Downe is the manager of the London branch of the American Radiator Company.

Chances for Business.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect until 3 P. M., August 22, 1906, for the low pressure steam heating apparatus complete in place in the U. S. Post Office and Court House building at Deadwood, S. D.

Indianapolis, Ind.—Sealed proposals, in triplicate, will be received at the office of the Board of Commissioners for the Southeastern Hospital for the Insane until 12 o'clock noon, August 21, 1906, for all labor and material necessary to complete the various buildings, pipe-tunnels, heating and power equipment, exclusive of the plumbing, electric wiring and sewer work.

Memphis, Tenn.—Bids will be received at the office of the Shelby County Court House Commissioners until September 5, 1906, for the general work, plumbing, gas and drainage work, heating and ventilating street fronts of marble, granite, store or brick and terra cotta in construction of court house.

Hamilton, Ont.—Bids will be received at the office of the Clerk of the Board of Education, at the Central High School building, until 12 o'clock noon, August 20, 1906, for a steam heating system for the Fifth Ward school building.

New England Foundrymen's Association held an outing August 9 last at the

Wing's Disc Fans

FOR FORCING OR EXHAUSTING AIR

The Original
The Strongest
The Most Efficient

Send for Catalogue and Reference List of some 800 names of users.

MANY THOUSANDS IN USE

L. J. WING MFG. CO.
136 Liberty Street, New York

Manufacturers of

WING'S Disc Fan and Combinations
WING'S Fans and Turbine Engines for Forced Draft, etc.
WING'S High Speed Steam Engines
WING'S Acetylene Generators, etc.

Squantum Club, Providence, R. I., which was arranged for by the Providence members. A short dinner was served.

The Manufacturer and His Advertising

To one in the business there is a wide difference in the status of advertising and is regarded by the general advertiser and the seller of machinery, mechanical appliances and the like. With few exceptions the latter using almost exclusively what are termed the technical and trade journals does not take the matter of advertising very seriously and this may explain much. There is a vague, indefinite feeling that there is good in it and that it is the proper thing to spend something during the year to keep one's name up and so the thing is done, but without any great expectations or the expenditure of more than the minimum enthusiasm.

If users of advertising space in the technical and trade papers knew the good that would result from a systematic and dutiful attention to their advertising, instead of the happy go lucky way in which this end of their business is usually conducted, they would no longer miss the fine possibilities it affords.

The matter of advertising naturally comes within the scope of the sales department and should be considered in conjunction with it. Working in accord with the sales manager, the men on the road, in the branch offices, it can accomplish much to the advantage to all.

Just as soon as the matter of advertising is talked about there is a noticeable quickening in the business life of a concern as a whole; when it is actually entered upon, the benefit is decidedly apparent. Everyone appreciates the fact that something is being done by "those higher up" to push things, and each instinctively gets to work with a surer grip in the effort to make good.

The branch offices and men on the road gradually feel the movement of the vital forces in motion at the other end of the line, and strive in turn for a better showing, partly from a natural pride in pulling their share, and partly that they, too, may reap the greater benefit from the help thus given, while it is to be had.

The result is a vim and "go" that breed dollars.

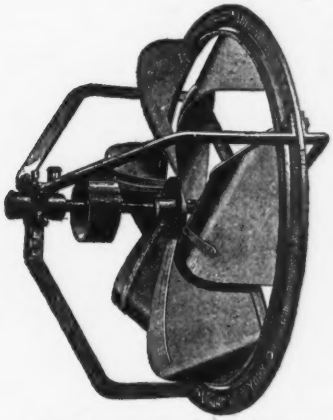
There is nothing else quite as sure for good in a case of "dry rot," threatened or arrived, as advertising.

Neither is there anything more reliable as a general business tonic.—W. Hull Western in *American Industries.*

Steam Heating Boiler for Sale

I have a "Dunning" portable steam heating boiler, catalogue style No. 3½, with 1,000 square feet direct radiation capacity, complete with all necessary trimmings, firing tools, etc., ready to set up, used three seasons, which I have replaced with a larger size, and which I now desire to sell at once. Price $75.00 cash f. o. b. cars at this station. Correspondence invited.

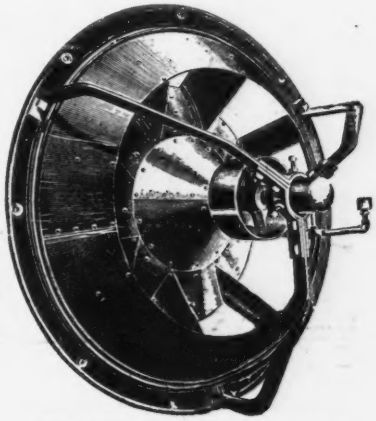
W. E. ADAIR.
Cohocton, N. Y.



ONE TYPE OF BLACKMAN.

PUSH
OR
PULL
AIR

The Blackman
and
Duplex Cone
Types



ONE TYPE OF DUPLEX CONE.

EXHAUST AND PRESSURE

WITH DIRECT CONNECTED ELECTRIC MOTORS OR STEAM ENGINES

FOR CATALOGUES, LIST OF USERS, SURVEYS AND ESTIMATES, ADDRESS

HOWARD & MORSE, 45 Fulton St., New York

MANUFACTURERS, ENGINEERS AND CONTRACTORS

Contracts Awarded

O'Toole Brothers, Clinton, Mass., heating, ventilating and plumbing new houses in Reading.

Blumve & Jay, Los Angeles, Cal., steam heating the new Bixley hotel at Long Beach.

R. T. Ford Co., Rochester, N. Y., installing the heating apparatus in the new armory at Oswego.

McCullom Plumbing & Heating Co., Muskegon, Mich., heating the Northern Hotel at Big Rapids. The contract is worth $5,000.

E. D. Hough, Los Angeles, Cal., installing the ventilating system in the Los Angeles Gas & Electric Company building.

Charles L. Anderson, Ishpeming, Mich., steam heating the new high school building at Norway. His bid was $6,500.

Littleton Hardware Co., Littleton, N. H., installing the heating plant in the Forest Hills Hotel and the Bethlehem schoolhouse.

Fargo Plumbing & Heating Co., Fargo, N. D., heating the Concordia College, Moorhead.

Bywater & Groo, Salt Lake City, Utah, heating the Plain City and Hooper new school buildings.

Lewis & Kitchen, Kansas City, Mo., furnishing the heating apparatus in the Kramer school, at their bid of $2,658.

West Virginia Heating & Plumbing Co., Charleston, W. Va., plumbing and heating the new $60,000 courthouse at Logan.

Frontier Plumbing & Heating Co., Buffalo, N. Y., steam heating and ventilating the new addition to Public School No. 52.

E. W. Webster, Du Bois, Pa., heating the $25,000 addition to the C. E. Patton theater at Curwensville, Pa.

John O'Neill & Sons, Peoria, Ill., heating the new Supreme Court building at Springfield. The consideration is $24,733.

B. O. Paulsness, Leeds, N. D., heating the new school building. The contract is worth $1,725.

J. L. Judge, Minneapolis, Minn., heating the new state sanatorium for consumptives at Walker, at his bid of $2,220.

Lawrence Hardware Co., Butler, N. J., heating and ventilating the new public schools at Wyckoff and Campgaw.

Wolverine Co., Richmond, Ind., installing a heating plant in school building No. 11.

Metal Construction Co., Des Moines, Iowa, plumbing and heating the new

PIPE HANGERS

Malleable Iron Pipe Hangers and Adjustable Beam Clamps

Send for Catalogue.

FEE & MASON

81 BEEKMAN STREET, N. Y.

No Legs.

In ordinary heating systems, steam without pressure is of no more use than a workman without legs. He may be ever so efficient, but he can't "get there." But the

WEBSTER SYSTEM OF STEAM CIRCULATION

carries low-pressure steam anywhere, and gives each occupant exactly the temperature he wants. It keeps you warm in zero weather or "just takes off the chill" on a damp morning in May. And in economy it is unrivalled.

Write for booklet 17-H.

WARREN WEBSTER & Co.
CAMDEN, N. J.

Building being erected by the Harbach Furniture Co. The consideration is $2,000.

Daniel L. Hood, Westfield, Mass., installing a heating plant in the town farm building, at his bid of $1,896.

C. F. Worley & Son, Shelbyville, Ill., steam heating the Main street school.

Ross, Dye & Cowgill, Central City, Neb., installing the steam heating plant in the High School building in Clarks. The contract is worth $1,985.

Scot Co., Oelivein, Iowa, steam heating the Jamison-Martin three-story block.

National Plumbing & Heating Co., Pittsburg, Pa., plumbing and heating 14 fine residences being erected on the Schenley Farm site, East End.

Wells & Newton, Pittsburg, Pa., heating the new addition to the office building for the Philadelphia Company.

Arms & Cole, Traverse City, Mich., heating the school building in Manton, Mich.

Frederick & Co., Carlisle, Pa., installing a heating plant and plumbing in the Mercersburg Academy.

Alex. Cameron, Southampton, N. Y., plumbing, heating and ventilating the Southampton Union School.

Philip McGraw, Mankato, Minn., steam heating St. Anne's school at Le Sueur.

George Thomas, Mt. Pleasant, Iowa, steam heating the New London schoolhouse, at his bid of $2,000.

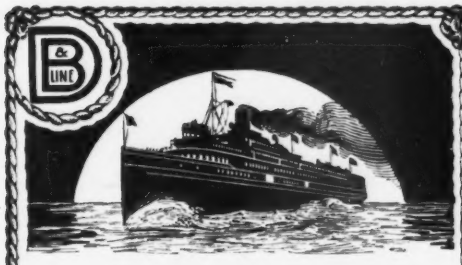
Chafer-Becker Co., Cleveland, O., steam heating the Cleveland Telephone Company building.

McGuinness-Smith Co., Pittsburg, Pa., heating and plumbing the $15,000 parsonage at Steubenville, O.; also heating the Vincent Scott & Company building on Penn avenue, Pittsburg.

W. I. Gray & Co., Minneapolis, Minn.,

HEAT YOUR HOUSE SAVE 25 PER CENT

With our VACUUM-VAPOR method of steam heating we guarantee a saving of 25 per cent in fuel. This method will raise vapor from cold water in 20 minutes. Has no air valves on radiators, hence no leaking or hissing—no pounding—absolutely noiseless—every radiator hot from end to end. Unsatisfactory steam or hot water systems can be changed to our method at small cost and without tearing up your house. Send for booklet. VACUUM-VAPOR CO., Moline, Ill.



Across Lake Erie

BETWEEN

TWILIGHT AND DAWN

The D. & B. Line Steamers leave Detroit weekdays at 5:00 p. m., Sundays at 4:00 p. m. (central time) and from Buffalo daily at 5:30 p. m. (eastern time) reaching their destination the next morning. Direct connections with early morning trains. Superior service and lowest rates between eastern and western states.

Rail Tickets Available on Steamers

All classes of tickets sold reading via Michigan Central, Wabash and Grand Trunk railways between Detroit and Buffalo in either direction will be accepted for transportation on D. & B. Line Steamers.

Send two cent stamp for illustrated pamphlet. Address, A. A. Schantz, G. S. & P. T. M., Detroit, Mich.

DETROIT & BUFFALO STEAMBOAT CO.

GARDNER ENGINEERING CO.

Consulting Engineers
Machinery Dealers

136 LIBERTY STREET, NEW YORK

WILLIAM T. DONNELLY MEM. A. S. M. E. — JAMES A. DONNELLY MEM. A. S. H. & V. E.

VANDERBILT BUILDING NEW YORK, N. Y.

POSITIVE DIFFERENTIAL SYSTEM OF EXHAUST STEAM CIRCULATION

SEND FOR BOOKLET

Vacuum Steam Heating

SOLE OWNERS MORGAN PATENTS

THE MARVELOUS FUEL SAVER WRITE AT ONCE FOR NEW CATALOGUES

CHICAGO MINNEAPOLIS **Kellogg-Mackay-Cameron Co.** KANSAS CITY SEATTLE

heating and ventilating the Lake Harriet school.

Iron City Heating Co., Pittsburg, Pa., heating the new St. James' school on Mount Oliver, Pittsburg.

Lewis & Kitchen, Chicago, Ill., heating and ventilating the new manual training school of Marshalltown, Iowa. The contract amounts to about $8,000.

Putnam Foundry & Machine Co., Providence, R.I., installing the new heating apparatus in the A. P. Hoyt school. The consideration is $4,500.

Buckeye Heating & Supply Co., Cleveland, O., heating a new eight-story hotel in that city.

American Warming & Ventilating Co., Pittsburg, Pa., heating a $25,000 school building at Youngwood, Pa.

Peter Wreisner, Dassel, Minn., hot water heating the parsonage of the Lutheran congregation at Stockholm, Minn.

Abbott Heating Co., Seattle, Wash., heating the new Lincoln school. The bid was $15,855.

Bernhardt Gause, Jacksonville, Ill., installing a new heater in the high school building. The contract is worth $2,500.

Thomas & Smith, Chicago, Ill., installing the heating and ventilating system in the heating plant for two school buildings, at their bid of $7,745.

Bauer & Fischer, Appleton, Wis., installing and furnishing a heating and ventilating plant in the county jail.

W. H. Johnson & Sons Co., Indianapolis, Ind., installing the steam heating plant and plumbing in four of the city school buildings. The consideration is $8,472.

Bremholz Brothers, Ambridge, Pa., plumbing and heating the new bank, office and apartment building at Rochester, Pa.

Wallace & McNamara, Des Moines, Iowa, plumbing and heating the State Historical Building, at their bid of $17,125.

Cambria Plumbing & Heating Co., Johnstown, Pa., heating and plumbing 20 double houses at Hollidaysburg, Pa.

Dwyer Plumbing & Heating Co., St. Paul, Minn., heating and ventilating the Auditorium building in Stillwater. The contract is worth $10,810.

Pond & Hasey Co., Minneapolis, Minn., heating the high school building in Greenfield. The consideration was $3,980. Also heating the Sidney Pratt and Corcoran schools in Minneapolis.

B. F. Sturtevant Co., Boston, Mass., heating and ventilating the new Good Samaritan Hospital.

E. G. Grant, Uxbridge, Mass., hot water heating the Hudson block.

Gruenwald, Schroeder & Co., Omaha, Neb., plumbing, heating, ventilating and lighting the new Y. M. C. A. building. The contract amounts to $17,583.

Butler Plumbing & Heating Co., Erie, Pa., plumbing and heating the new $12,000 house of Thomas J. O'Connor.

Engleby & Bros. Co., Roanoke, Va., heating the Masonic building at Bedford City, Va., and installing a steam heating plant in the Randolph and Macon Academy at Port Royal, Va.

W. E. Bennlinger, Oakdale, Pa., heating a new residence at Rennerdale.

J. W. Cuff & Co., Philadelphia, Pa., heating and ventilating the Spencer Miller public school, at their bid of $8,720.

A. R. Leeke, Hartford, Conn., heating and plumbing the South School.

Sales Manager Wanted.—By a brass manufacturing concern, making a complete line of valves, fittings and brass specialties. Must have extensive practical sales and manufacturing experience in this line. Write, stating age, references, experience and salary expected. Address Gordon, care of Heating and Ventilating Magazine, 1123 Broadway, New York.

BOUND VOLUMES OF

The Heating and Ventilating Magazine

Comprising, under one cover, Vols. I and II.
Suitably Bound in Cloth and Containing Full Cross Index

PRICE, Sent Postpaid to any Address in U. S., $3.00

ADDRESS

Heating and Ventilating Magazine, 1123 Broadway, New York